Erie-Niagara Basin

Chemical Quality Of Streams

ERIE-NIAGARA BASIN REGIONAL WATER
RESOURCES PLANNING BOARD

THE NEW YORK STATE WATER RESOURCES COMMISSION

CONSERVATION DEPARTMENT • DIVISION OF WATER RESOURCES

ENB-4

CHEMICAL QUALITY OF STREAMS IN THE ERIE-NIAGARA BASIN, NEW YORK

Prepared for the
Erie-Niagara Basin Regional Water Resources Planning Board

by

R. J. Archer, A. M. La Sala, Jr., and J. C. Kammerer

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
in cooperation with
THE NEW YORK STATE CONSERVATION DEPARTMENT
DIVISION OF WATER RESOURCES

STATE OF NEW YORK
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Basin Planning Report ENB-4
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CHEMICAL QUALITY OF STREAMS IN THE ERIE-NIAGARA BASIN, NEW YORK

By

R. J. Archer, A. M. La Sala Jr., and J. C. Kammerer

ABSTRACT

The streams in the 2,000-square-mile Erie-Niagara basin of western New York contain mainly a calcium bicarbonate type of water whose dissolved-solids content generally varies between 140 and 240 ppm (parts per million). Water "hardness" (expressed as $CaCO_3$) is usually between 100 and 200 ppm, sulfate concentrations are between 20 and 60 ppm, and chloride between 5 and 20 ppm. The higher concentrations of these constituents and properties are representative of the northern part of the area, which is underlain by the gypsum-bearing Camillus Shale. The northern part of the area contains a predominantly calcium sulfate type of water that usually has a dissolved-solids content of between 250 and 750 ppm, sulfate between 40 and 350 ppm, chloride between 20 and 70 ppm, and hardness between 200 and 500 ppm.

The dissolved-mineral content of shallow ground water is the principal influence upon the chemical quality of the streams, except during and soon after periods of dilution by heavy precipitation or snowmelt. The average dissolved-mineral content of precipitation is about 35 ppm of dissolved solids, but substantially higher concentrations, as much as 327 ppm, have occurred. These high concentrations are attributed to industrial air pollution in the Buffalo area.

The report contains chemical analyses of more than 700 samples collected mainly during 1963 and 1964, including samples of precipitation and overland flow. Utilizing these data, maps and graphs show significant regional and time variations in the natural water quality.

INTRODUCTION

The purpose of this report is to describe the chemical quality of water in streams in the Erie-Niagara basin, including the variations from place to place and from time to time. Emphasis is largely on the "natural" quality of water, unaffected or but little affected by man's activities. The many chemical analyses made during the project, mostly in 1963 and 1964, are presented in full (mainly at the end of the report) along with illustrations and summary tables that are intended to make the report as readily usable and understandable as possible to water users, planners, and managers.

Conclusions are drawn, not only about the types of water in the area, but also about the reasons for its quality, that is, why does one water contain more dissolved mineral matter than another, and why and in what manner does this quality vary in place and time? From a knowledge of the causative factors and their relative influence, the local and regional situations become more fully understood and apparent, and reasonable assumptions can be made of the chemical quality of streams even where the quality has not been determined by laboratory analyses.

The New York State Health Department made studies on the sanitary quality of streams a part of its work for the Board. With few exceptions, the reaches of streams known to receive large quantities of municipal and industrial wastes have not been sampled by the Geological Survey, because of changes in natural chemical quality occurring as a result of the effluent discharge. Therefore, stream pollution is mentioned only briefly in this report.

The preparation of this report on chemical quality of streams has been concurrent and closely coordinated with associated Geological Survey reports on ground water (LaSala, 1968), on the flow of streams (Harding and Gilbert, 1968), and on fluvial sediment (Archer and LaSala, 1968). These three reports have been freely drawn upon for information on the quality of ground water, the magnitude and variations in the flow of streams, and the discharge of ground water to streams. The reader is referred to them for more detailed data on those subjects.

Sampling sites referred to in this report are numbered under several systems according to the types of samples. These systems are explained in Appendix A, "Numbering System for Sampling Sites." The basic data tables (tables 14 to 25) in Appendix B list the detailed results of the chemical analyses and a cross index of the sampling points.

SCOPE OF CHEMICAL-QUALITY STUDY

This study has been directed entirely toward collecting and evaluating water-quality information about the streams of the region, even though thousands of people and many industries depend upon Lake Erie rather than local streams for their water supply, especially in Buffalo and adjacent areas. The point is that many of the quantity and quality characteristics of Lake Erie are generally well known (see for example New York State Dept. of Health, 1953), whereas such has not been the case for most of the local streams. Furthermore, economic considerations presently preclude distribution of water from Lake Erie to the central and eastern parts of the region. Water needs in these parts of the region will continue to be developed from inland sources, and the water-quality data in this report will aid in the development of these sources.

In order to gain a broad knowledge of the factors affecting the chemical quality of streams, the Geological Survey included in this study not only the sampling and analyzing of water in streams themselves, but also some chemical analysis of the "prestream" water environment -- that is, of rain and snow, the sources of water which eventually appear in streams. Some analysis was made also of overland flow -- water that flows over the land surface to the streams. From these analyses an assessment was made of the effect of precipitation and overland flow on the chemical quality of streamflow.

A major part of the time and effort of this study was devoted to sampling and analyzing streams at very high and very low flows, so as to define the range in quantity of mineral matter in the water from the most dilute concentrations to the most mineralized. In order that the extremes of chemical-quality values at times of very high and very low streamflow might represent region wide conditions at a selected time, a special effort was made to achieve as nearly a simultaneous sampling as possible throughout the area, within practical limits of cost and available manpower. Accordingly, most of the high-flow sampling was done during a period of thaw on March 4 and 5, 1964; and most of the low-flow sampling during a predominantly dry period of summer, on July 2, 4, and 5, 1963.

A summary of the types and magnitude of all chemical-quality data obtained for streams and for precipitation by the Geological Survey is shown in table 1. Plate 1 shows locations of all stream-sampling sites, and figure 3 shows locations of all precipitation-sampling sites. Locations of overland-flow sites are indicated in table 16.

Table 1.--Summary of kinds of samples collected, and types and number of chemical analyses tabulated in this report

Note: In the table below, a "partial" analysis includes determination of less than 12 constituents or properties, generally including some or all the following: SO_4, Cl, specific conductance, Ca or hardnesss, and pH; a "complete" analysis includes determinations of 12 or more constituents or properties which, in addition to those previously listed, generally include many or all the following: SiO_2, Fe, Mn, Mg, Na, K, CO_3, HCO_3, F, NO_3, dissolved solids (residue on evaporation), and color.

Kind of sample collected	Number of sites	Number of analyses 1963-65 Partial	Number of analyses 1963-65 Complete	Number of analyses Prior years Partial	Number of analyses Prior years Complete	Table containing data
Precipitation (Mar.-Sept.,1963)	7	105	--	--	--	13
Snow (mainly Feb. 17-18, 1964)	59	71	--	--	--	14
Overland flow (mainly in Cattaraugus Creek basin Mar. 5 and 9, 1964)	17	17	--	--	--	15
Streamflow						
High flow (mainly Mar.4,5,9, 1964)	134	163	--	--	--	16
Low flow (mainly July 2,4,5, 1963)	163	174	32	1	--	17,18
Additional sampling, Occasional	41	--	1/ 56	--	24	18
Daily or 10-day composites	2/ 4	--	--	34	89	19-22

1/In addition to these 56 analyses, 32 other complete analyses are included in table 19, of samples collected on July 2 or 5, 1963, at a time of low streamflow; selected constituents from these 32 analyses are also given in the table of low-flow analyses (table 18).

2/Includes 2 sites near, but outside of the Erie-Niagara basin.

BRIEF LOOK AT CHEMICAL QUALITY OF STREAMS IN THE REGION

The water in streams in much of the Erie-Niagara basin is similar in chemical quality, at least in the total of dissolved mineral matter (between 150 and 500 parts per million), to that supplied by municipal water supplies to about 40 million people in the United States (Durfor and Becker, 1964b). The notable exception is the northern part of the area, principally in the Tonawanda Creek basin west of Batavia, where the quantities of dissolved mineral matter are much higher.

Tables 2 and 3 show some of the chemical characteristics typical of the region, a few of the streamflow characteristics, and physical and geologic characteristics of the four streams selected as examples; also included is a chemical analysis of Lake Erie or the Niagara River water for comparison. Although the stream sampling indicated by the two tables is limited to only four specific sites, each sample, in effect, represents a composite of the characteristics (of the chemical quality) of the entire stream basin upstream from that site. The locations of these four streams and sites are shown in figure 1 as well as in plate 1.

The data in table 2 are typical of median conditions in each stream listed, whereas table 3 includes also some information on chemical quality of the water during times of very high (in three of the streams) and low flow (in all four streams). The data shown for Cayuga Creek and Little Tonawanda Creek represent conditions in the greater part of the Erie-Niagara basin (much of the Cattaraugus Creek basin has only slightly less mineralized water); the Tonawanda Creek and Ellicott Creek sites show the more highly mineralized water of the lower Tonawanda Creek basin. The wide variations in quality shown in the tables are caused mainly by geologic factors, which are discussed in later sections of this report.

For purposes of convenient comparison, tables 2 and 3 also contain chemical data on the largest source of water available to the region, Lake Erie. (The Niagara River water at Niagara Falls is Lake Erie water after it has moved only some 10 to 15 miles downstream from the lake.)

Table 4 compares three chemical characteristics at upstream and downstream sites on seven of the largest streams in the basin during low streamflow, and at most of these same sites, at very high flow. Note that the greatest contrasts in quality, with respect to both upstream-downstream changes and high flow-low flow changes, occur on Tonawanda and Ellicott Creeks.

Table 2.--Chemical analyses of water at times of moderate flows, in four representative streams, 1963; and of Lake Erie water at Buffalo, Aug. 22, 1961

(All chemical results in parts per million, unless otherwise noted)

Stream site number: USGS / N.Y.State	2150 / E1-6(11.0)	2165 / 0158-12-32(9.4)	2180 / 0158-12(19.5)	2185 / 0158-12-1(14.1)	
Stream site:	Cayuga Creek near Lancaster	Little Tonawanda at Linden	Tonawanda Creek at Rapids	Ellicott Creek at Williamsville	Lake Erie at Buffalo 1/
Date of collection:	5-8-63	5-8-63	5-8-63	5-8-63	8-22-61
Stream discharge:	28 cfs	9.9 cfs	165 cfs	24 cfs	--
Silica (SiO_2)	0.1	3.1	1.5	1.0	2.0
Iron (Fe)	.03	.14	.15	.14	.01
Manganese (Mn)	.01	.00	.01	.02	.00
Calcium (Ca)	48	52	102	86	38
Magnesium (Mg)	13	10	16	14	8.6
Sodium (Na)	6.2	4.2	12	22	9.5
Potassium (K)	2.0	1.3	1.7	2.8	1.4
Bicarbonate (HCO_3)	149	172	219	196	116
Carbonate (CO_3)	0	0	0	0	0
Sulfate (SO_4)	43	28	134	103	23
Chloride (Cl)	14	6.8	31	42	23
Fluoride (F)	.1	.1	.2	.3	.1
Nitrate (NO_3)	1.4	1.2	1.8	1.0	.2
Dissolved solids	205	196	437	384	177
Hardness as $CaCO_3$ Ca,Mg	174	171	321	272	131
Noncarbonate	52	30	141	112	36
Specific conductance (micromhos at 25°C)	370	348	675	626	306
pH	8.1	8.1	7.4	7.7	8.0
Color	3	4	7	8	1
Turbidity	.0	.0	.4	.6	.0
Temperature (°F)	59	62	62	62	75

1/ From Durfor and Becker, 1964a, p. 250.

Table 3.--Chemical characteristics of water during high, moderate, and low flows of four streams, representing various geologic and topographic environments; and of water in the Niagara River at Niagara Falls

Stream site; Stream site number N.Y.State; USGS	Drainage area (sq mi)	Period of streamflow record	Average discharge (cfs)	Physical setting of basin	Major type of rocks underlying river basin	Sample collection: Date	Sample collection: Discharge (cfs)	Iron (Fe) (parts per million)	Sulfate (SO_4) (parts per million)	Chloride (Cl) (parts per million)	Dissolved solids (parts per million)	Hardness as $CaCO_3$ (Ca,Mg) (parts per million)	pH
Cayuga Creek near Lancaster El-6(11.0); 2150	93.3	1938-64	123	Upland and lowland	Shale	Apr.16,1964	66	0.07	39	11	189	143	8.0
						May 8,1963	28	.03	43	14	205	174	8.1
						July 5,1963	6.00	.07	52	13	227	168	7.6
Little Tonawanda Creek at Linden 0158-12-32(9.4);2165	22.0	1912-64	27.2	Upland	Shale	Mar. 5,1964	1/ 709	--	19	--	100	--	--
						May 8,1963	9.9	.14	28	6.8	196	171	8.1
						July 2,1963	1.84	.11	33	6.4	234	201	7.9
Tonawanda Creek at Rapids 0158-12(19.5);2180	358	1955-64	366	Lowland and upland	Camillus Shale; limestone;other shale	Mar.19,1963	4,600	--	35	16	176	114	7.8
						May 8,1963	165	.15	134	31	437	321	7.4
						July 2,1963	48.0	.09	240	48	650	455	7.4
Ellicott Creek at Williamsville 0158-12-1(14.1);2185	76.3	1955-64	86.1	Lowland	Limestone (underlain by Camillus Shale);	Mar.19,1963	1,240	--	33	13	150	92	7.4
						May 8,1963	24	.14	103	42	384	272	7.7
						July 2,1963	.88	.03	353	57	717	486	7.9
Niagara River at Niagara Falls 0158(19.6);2160	2/ 260,400	2/ 1860-1964	2/ 203,000			Jan. 6-10, 12,14,18,20,1959 3/	153,000 1/	.03	22	23	197	132	7.6
						Oct.1958-Sept.1959							
						Maximum concentrations		.08	27	25	203	144	7.8
						Minimum concentrations		.01	21	20	179	124	7.3

1/ Daily mean discharge.
2/ Drainage area, period of record, and average discharge shown above are for the gaged site at Buffalo, but these data for practical purposes are equally applicable to the sampling site at Niagara Falls.
3/ Composite sample.

Table 4.--Comparison of chemical characteristics of water in the larger streams during times of low and very high flow

STREAM Upstream and downstream sampling iste; site number, N.Y. State system, U.S.G.S. system where used.	Drainage area above site (square miles)	Very high flow March 18,19, or 20, 1963 or March 5 or 9, 1964 Sulfate (SO_4) (parts per million)	Chloride (Cl)	Hardness as $CaCO_3$	Low flow July 2 or 5, 1963 Sulfate (SO_4) (parts per million)	Chloride (Cl)	Hardness as $CaCO_3$
CATTARAUGUS CREEK (total drainage area, 554 square miles)							
UP: Near Arcade; E23(54.7); 2134.1	78.4	18	7.0	69	18	9.7	138
DOWN: At Gowanda; E23(17.4); 2135	432	23	5.2	90	41	37	177
EIGHTEENMILE CREEK (total drainage area, 120 square miles)							
UP: At North Boston; E23(15.3); 2142	37.2	24	7.5	64	43	19	168
DOWN: At Highland-on-the-Lake; E13(0.5); 2142.4	119	--	--	--	70	80	215
CAYUGA CREEK (total drainage area, 126 square miles)							
UP: At Cowlesville; E1-6(23.3)	43.1	--	--	--	48	24	190
DOWN: Near Lancaster; E1-6(11.0); 2150	94.9	--	--	--	52	13	168
BUFFALO CREEK (total drainage area, 149 square miles)							
UP: Near Wales Hollow; E1(31.8); 2144	80.1	23	5.8	78	41	10	190
DOWN: At Gardenville; E1(10.4); 2145	144	34	--	---	55	12	163
CAZENOVIA CREEK (total drainage area, 138 square miles)							
UP: East Branch Cazenovia Creek at South Wales; E1-4-14(8.1); 2153.5	38.0	22	11	56	38	12	146
DOWN: Cazenovia Creek at Ebenezer; E1-4(4.1); 2155	136	26	12	68	69	48	190
TONAWANDA CREEK (total drainage area, 631 square miles)							
UP: Near Johnsonburg; 0158-12(100.6); 2164	23.6	18	3.4	85	27	5.8	171
DOWN: At Rapids; 0158-12(19.5); 2180	352	35	16	114	240	48	455
ELLICOTT CREEK (total drainage area, 110 square miles)							
UP: Near Crittenden; 0158-12-1(39.9)	21.0	--	--	--	37	34	165
DOWN: At Williamsville; 0158-12-1(14.1) 2185	72.4	33	13	92	353	57	486

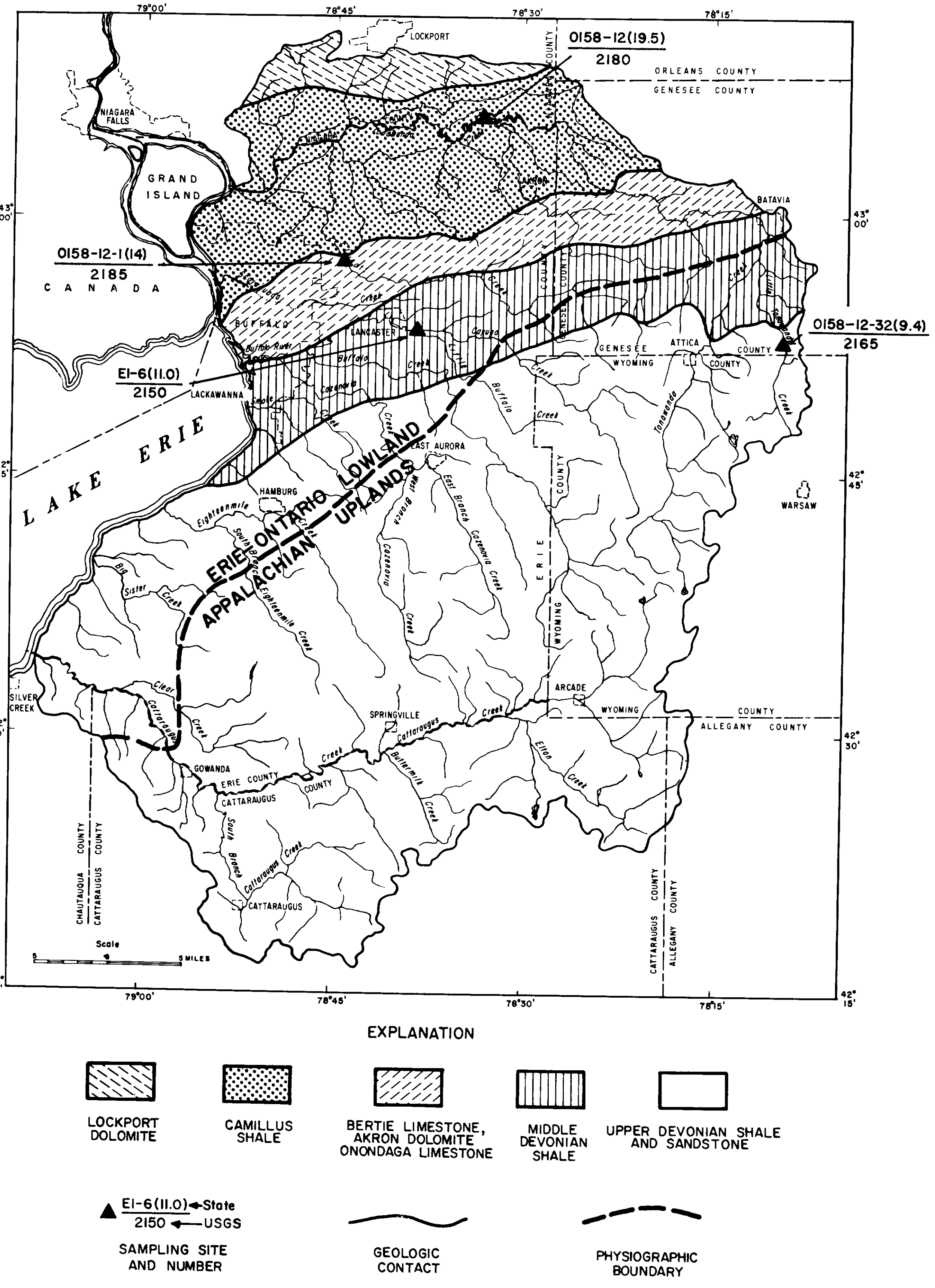


Figure 1.--Generalized bedrock geology and physiographic divisions.

CHEMICAL QUALITY AND THE WATER CYCLE

As water moves through different environments in the hydrologic cycle its chemical quality changes, as is indicated in figure 2. Precipitation dissolves materials present in the atmosphere and carries them to the land surface. Generally the dissolved solids in precipitation are very low, but precipitation in some areas gains a high concentration of dissolved solids from impurities in the atmosphere. After precipitation reaches the land surface, it is further modified chemically before reaching the streams. Most water reaches streams or lakes by flowing rapidly over the land surface. As it flows, the water dissolves materials from the soil and dust particles lying on the surface. Overland flow is nevertheless low in dissolved solids compared to average stream quality. A significant quantity of water also reaches the streams by infiltrating to the saturated zone and moving laterally in the subsurface as ground water. This water dissolves materials from the soil and rocks above the saturated zone (the zone of aeration) and from the materials in the saturated zone. The concentrations of dissolved solids in ground water within this area are high compared to average stream quality.

Ordinarily, because of the high frequency of precipitation in the Erie-Niagara basin, streams carry water which is a mixture of overland flow and ground water except during long dry periods. The relatively low dissolved-solids content of overland flow is the predominant controlling factor of the chemical quality of water in streams during floods and large flows. During periods of low streamflow, the quality of streamflow is largely determined by the quality of the ground water entering the streams.

Table 5 summarizes the major part of the analytical data obtained in the Erie-Niagara basin, including precipitation and overland flow. Also included are data on high streamflow, which is predominantly from overland flow, and data on low streamflow, which is almost entirely the contribution of ground water. The chemical characteristics and variations of these various facets of the water cycle will be discussed in the sections that follow.

PRECIPITATION

As water falls upon the earth as rain or snow it dissolves some of the impurities -- gases and particles -- in the atmosphere. The principal sources of the impurities are the fully or partly burned residues and gases discharged into the atmosphere by man from his home-heating systems, factories, automobiles, incinerators, and dumps. These impurities may return to the land near where they were earlier discharged, or may be windborne for many miles depending upon the kind, form, and concentration of the impurity, upon the wind currents, and upon the associated local and regional patterns of precipitation.

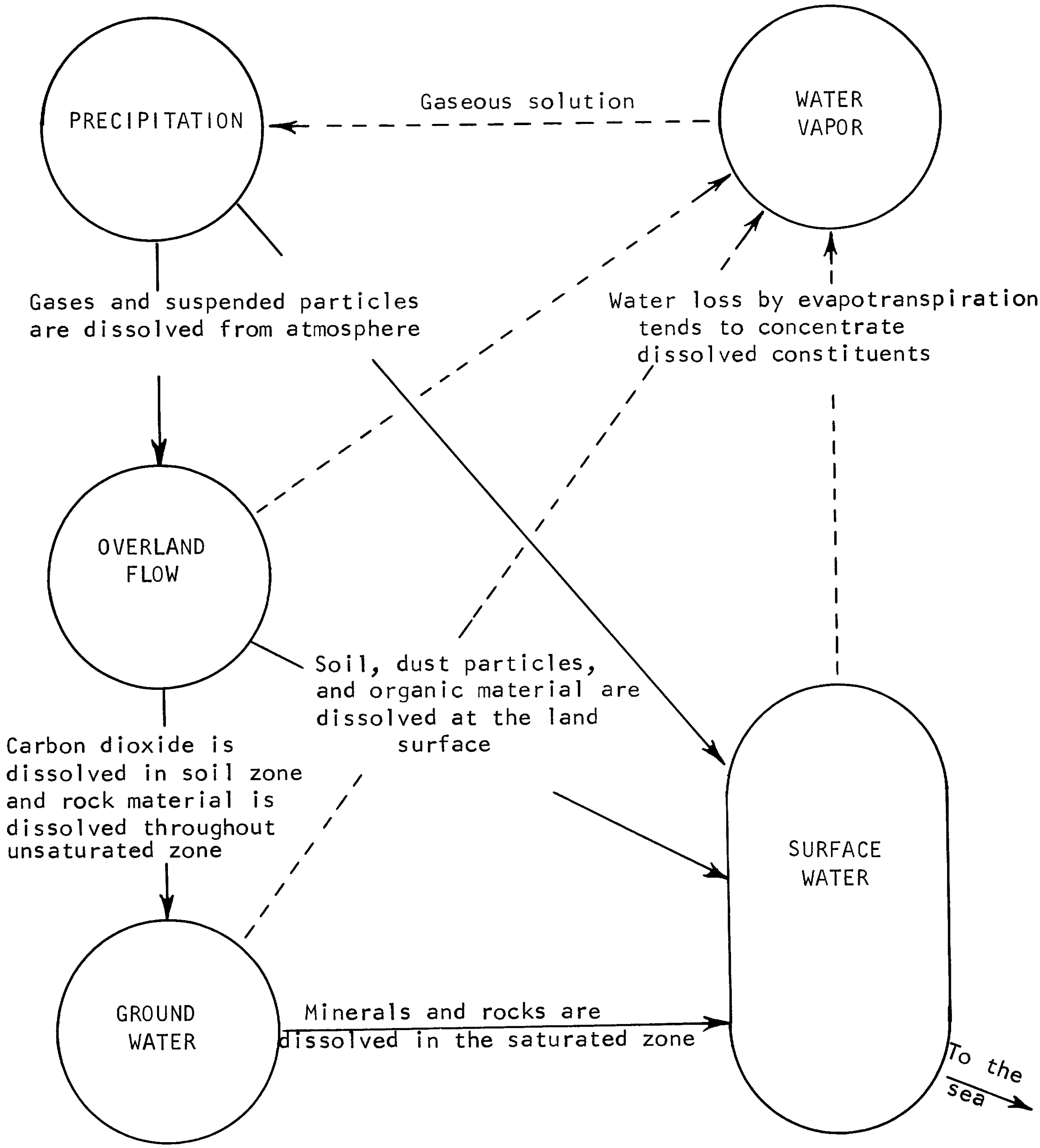


Figure 2.--Sources of dissolved constituents in water moving through the hydrologic cycle.

Table 5.--Representative ranges in selected chemical properties of precipitation and streamflow during parts of 1963 and 1964

Note: This table has been compiled from data in the tables in the back of this report by determining the "middle-80-percent" values--that is, the range of values remaining after the highest 10 percent and lowest 10 percent of data have been eliminated.

	Number of samples collected 1/	Calcium (Ca) (parts per million)	Sulfate (SO_4) (parts per million)	Chloride (Cl) (parts per million)	Dissolved solids (parts per million)	Specific conductance (micromhos at 25°C)	Hardness as $CaCO_3$ (Ca, Mg)	pH
Precipitation (1963)								
North of latitude 42°40'	59 (4 sites)	3-8	7-25	0.0-1.1	--	37-110	--	6.0-6.8
At and south of latitude 42°40'	46 (3 sites)	3-8	5-20	.0-.1	--	24-109	--	6.0-6.6
Snow (Feb. 17-18, 1964; Jan. 14, 1965; Feb. 2, 1965)								
North of latitude 42°40'	47 (35 sites)	1-10	1-167 2/	1-30	--	26-439	--	3.3-5.6
At and south of latitude 42°40'	24 (24 sites)	1-6	2-9	1-10	--	25-87	--	3.9-4.7
Overland flow (Mar. 5, 9, 1964)								
South of latitude 42°45'	13 (13 sites)	--	8-16	.6-1.5	--	38-264	14-19	--
High streamflow (Mar. 4, 5, 9, 1964)								
Tonawanda Creek basin west of Batavia	35 (32 sites)	--	19-48	5-18	123-260	118-361	40-112	--
All other parts of Lake Erie-Niagara area	106 (101 sites)	--	11-29	2-8	68-187	84-187	29-79	--
Low streamflow (July 2, 4, 5, 1963)								
Tonawanda Creek basin west of Batavia	28 (27 sites)	80-165	37-1,190	22-107	410-717	399-2,070	163-1,410	7.3-7.9
All other parts of Lake Erie-Niagara area	136 (135 sites)	44-61	21-80	6-53	170-296	286-599	126-244	7.0-8.3

1/ Number of specific conductance samples; fewer samples were taken for other characteristics and constituents.

2/ "Middle-80-percent" range for snow of Feb. 17-18, 1964, considered separately, was 5-174 ppm SO_4.

However, the likelihood of significant quantities of atmospheric impurities being available for solution by precipitation, increases considerably near highly industrialized areas. Buffalo, particularly because of its amount of heavy industries, is the source of considerable smoke and fumes, which are carried eastward by the prevailing winds. Atmospheric impurities from the Great Lakes industrial region to the west probably are also carried into the area.

Although the concentrations of most dissolved constituents in precipitation are usually small, generally totaling less than 50 ppm in inland regions (Junge and Werby, 1958), the concentrations of some constituents are large enough to be measurable by routine methods of chemical analysis. Also, the concentrations occasionally are found to be significantly higher than 50 ppm, as was the situation for a large number of samples of the snowfall of February 16, 1964, collected in the northern part of the Erie-Niagara basin.

Precipitation from moderate or large storms that occurred between March and September 1963 was sampled at seven U.S. Weather Bureau stations, and snow from the storm of February 16, 1964, was sampled at 59 sites. The results are summarized in table 5 and in figure 3, which include locations of all sampling sites. Additional snow samples were collected at six of the same sites on January 14 and February 2, 1965. Chemical data on all the samples from the Weather Bureau Stations are given in table 14, and the analyses of snow are in table 15.

Table 5 and figure 3 show that the quality of most of the samples collected at the Weather Bureau Stations varied within relatively narrow ranges during 1963, such as 3-8 ppm of calcium; 5-25 ppm of sulfate; 0-1.1 ppm of chloride; 20-70 ppm of dissolved solids (estimated from specific conductance values in the range from 24 to 110 micromhos). However, some unusually high values were recorded in a few of the analyses of rainfall, such as 26 ppm of calcium, 99 ppm of sulfate, and 6.7 ppm of chloride (each at a different site).

Precipitation was higher in dissolved solids at the Weather Bureau Stations downwind from Buffalo than at those stations on a line south of Buffalo. An exception is the station at Gowanda, which is near a local source of air pollution. The median dissolved-solids concentration (estimated from specific conductance) at Linden, due east of Buffalo, was about two times the median concentrations at Arcade, in the southwest corner of Wyoming County, and at Colden, southeast of Hamburg.

Figure 3 shows the areal variations in calcium, sulfate, chloride, and specific conductance from the sampling of the snowstorm of February 16, 1964. The winds during this storm were from the southwest, and there is a significant areal variation in the snow data shown in figure 3. High values of sulfate concentration and specific conductance are more prevalent in samples from the northern half of the area. Apparently, this particular snowstorm dissolved a larger than usual amount of airborne impurities in the vicinity of buffalo, and carried them to the ground in much of the northern half of the study area. Snow samples from six of the

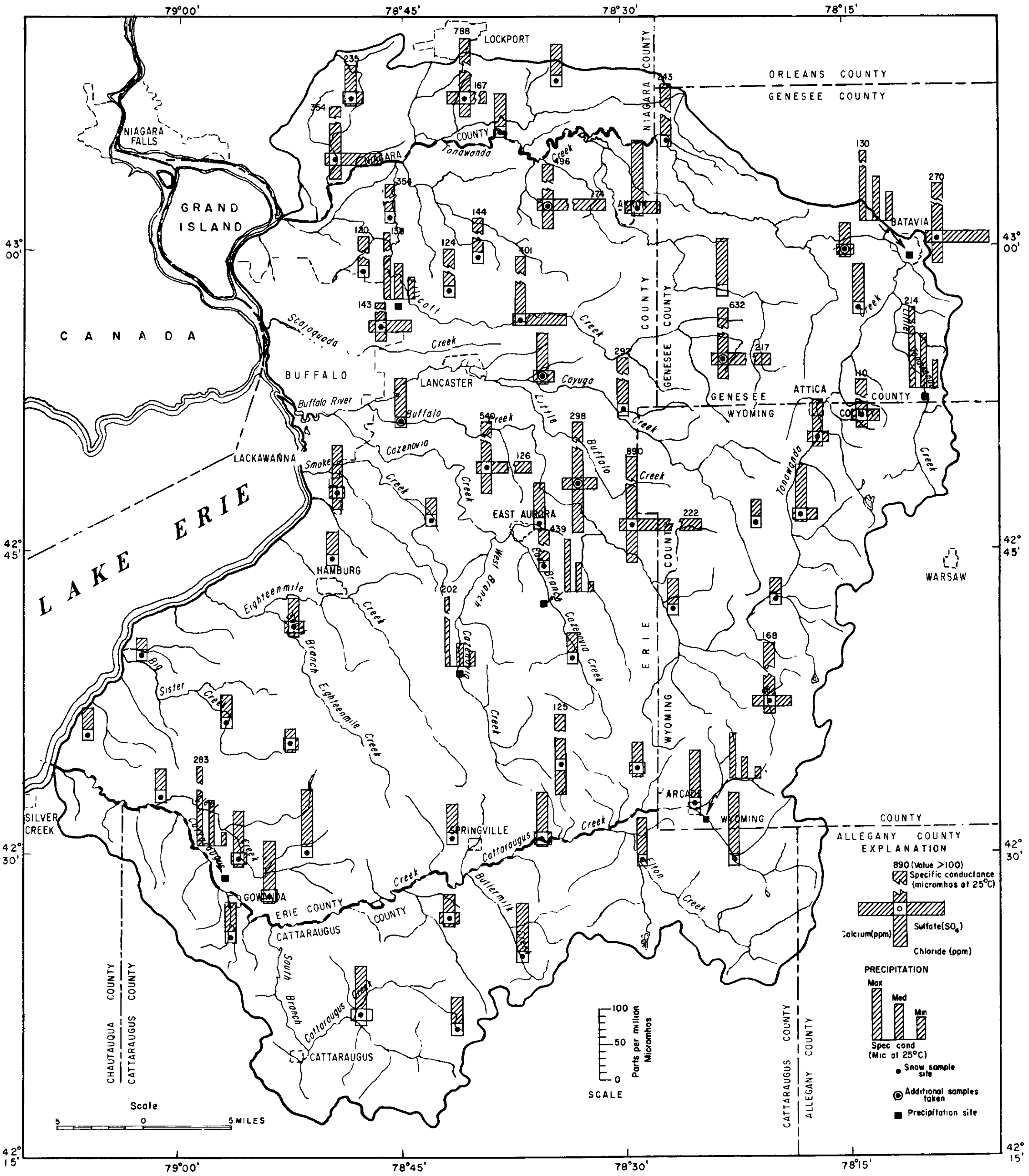


Figure 3.--Chemical quality of snow from the storm of February 16, 1964, and the maximum, minimum, and median observed specific conductance of samples collected at precipitation sites, March to September 1963.

same sites early in 1965, showed lower concentrations of sulfate, chloride, and dissolved solids that were more nearly comparable to the chemical quality of rainfall. Fairly typical chemical concentrations north and south of north latitude 42°40'00", for the storm of February 16, 1964, are about as follows:

	North (ppm)	South (ppm)
Calcium	6	2
Sulfate	60	4
Chloride	16	4
Dissolved solids	140	30

It should be noted that snow samples, both in 1964 and 1965, had consistently higher concentrations of chloride than the rainfall samples of 1963.

Regionwide, the streams of the Erie-Niagara basin receive precipitation containing, on an average, the following concentrations of the constituents listed:

	(Parts per million)
Calcium	5
Sulfate	10
Chloride	0.1
Dissolved solids	35

Somewhat higher concentrations commonly occur near or downwind from industrial area. Also, chloride concentrations of 5-10 ppm are common in snow.

OVERLAND FLOW

The part of precipitation that neither seeps into the ground nor evaporates moves over the land surface until it reaches a stream channel. The overland flow contains not only the chemical constituents dissolved by the precipitation from the atmosphere, but also constituents dissolved from the soil and exposed rock materials, evaporation residues, and atmospheric fallout that has accumulated since the preceding overland flow. Despite the variety of sources of impurities, only a small amount of dissolved material is normally added to the overland flow.

Most of the samples of overland flow which were collected and analyzed for the Erie-Niagara study were obtained in the Cattaraugus Creek basin, on March 5, 1964, concurrently with sampling of high streamflow. The cause of the runoff was a light to heavy rain and melting of a snowpack. The locations and analyses of all 17 samples of overland flow are given in table 16, and analyses of 13 of the samples are summarized on one line of table 5.

For the Cattaraugus Creek basin, the limited data show little increase in concentration of sulfate, chloride, and total dissolved solids, from that found in precipitation. The nine samples collected on March 5, 1964, had the following ranges of values:

	ppm	Samples
Sulfate	7.8 - 16	8
Chloride	.5 - 2.1	7
Hardness as $CaCO_3$	8 - 21	7
Dissolved solids	17 - 120 1/	9

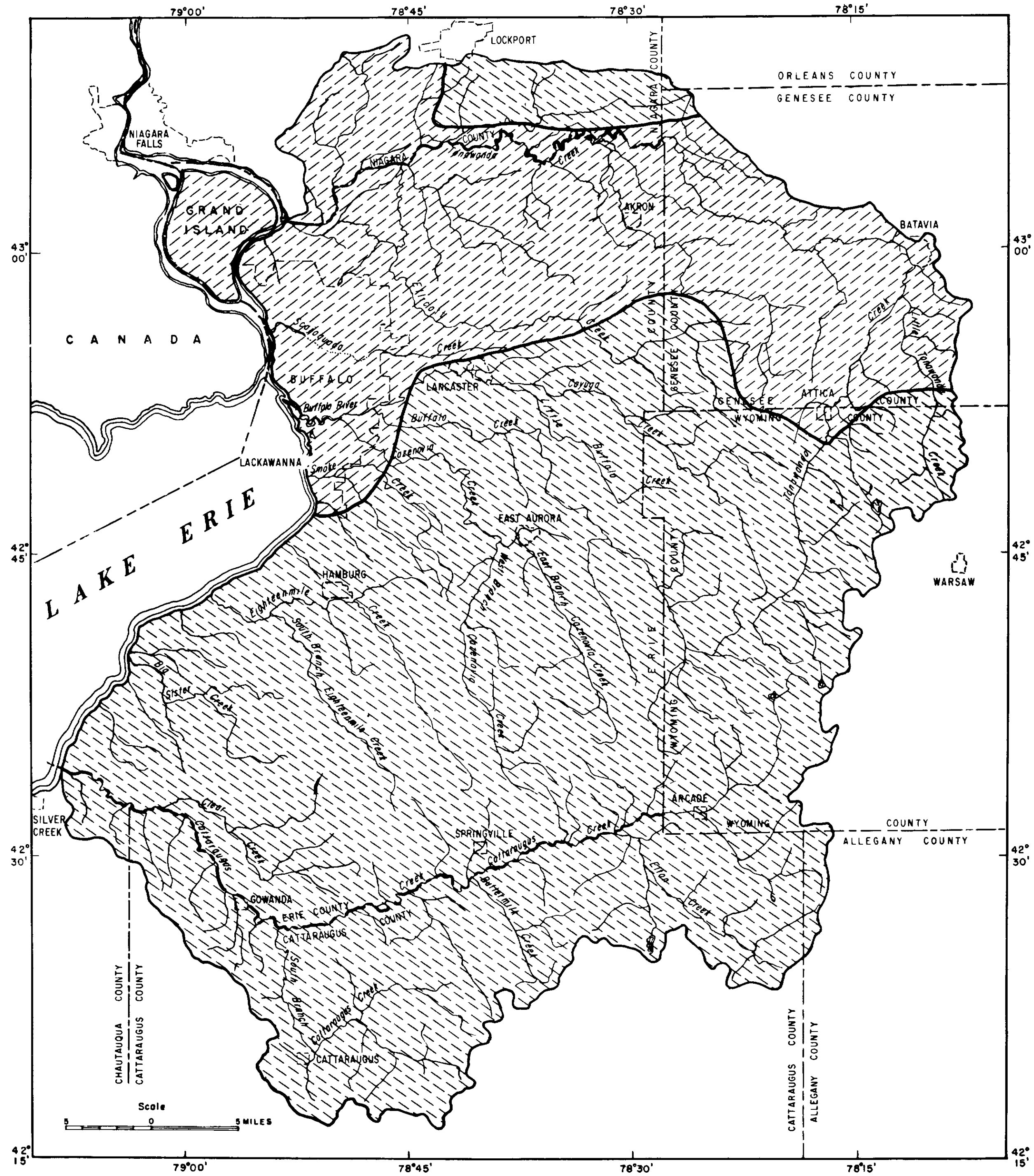
1/ Calculated by multiplying the specific conductance values by 0.67.

The chemical quality of the water in small streams during periods of high flow is representative to a large extent of the quality of the water in overland flow, because the water in the streams during those periods is derived largely, or entirely, from rain or melting snow. Therefore, the chemical analyses of very high streamflow (table 17) in small streams provide a more areawide picture of the chemical quality of overland flow. In most of the central and southern parts of the area the concentrations in parts per million were generally:

Sulfate, less than 20 ppm
Chloride, less than 10 ppm
Hardness (as calcite), less than 60 ppm (except in some parts of the Buffalo River basin)
Dissolved solids, less than 120 ppm

Higher concentrations at some sites in the southern and central parts of the area probably resulted from local pollution, such as an increase in chlorides from salt-treated roads. Because of both greater air pollution and higher rock solubilities in the northern part of the area, concentrations of sulfate and dissolved solids were noticeably higher in much of the Tonawanda Creek basin. Generally in most of the central and southern parts of the Erie-Niagara basin, the concentrations of sulfate were less than 20 ppm, chloride less than 10 ppm, hardness (as $CaCO_3$) less than 60 ppm (except in some parts of the Buffalo River basin), and dissolved solids less than 120 ppm. Higher concentrations at some sites in the southern and central parts of the area were probably the result of local pollution, including high chlorides from salt-treated streets and highways. Sulfate and dissolved-solids concentrations were noticeably higher in much of the Tonawanda Creek basin, a consequence of precipitation high in dissolved solids due to air pollution and also of the greater solubility of rocks in the northern part of the Erie-Niagara basin.

Figure 4 shows the general regional quality of overland flow in terms of specific-conductance determinations. The ranges in specific conductance shown in the figure correspond roughly to ranges of dissolved-solids concentrations of 16 - 100 ppm and 100 - 200 ppm, respectively. Note that the higher range applies to the Buffalo and to the lower Tonawanda Creek basins (northeast and east of Buffalo).



EXPLANATION

Specific conductance range, in micromhos at 25°C

25–150

151–300

Figure 4.--Specific conductance of overland flow.

From the information gathered about the first two prestream contributors of dissolved mineral matter, precipitation seems to contribute more dissolved minerals to the streams than overland flow. However, two possible exceptions exist: in the lower Tonawanda Creek basin, overland flow at times may dissolve unusually large amounts of atmospheric fallout that has accumulated on the land surface, and locally overland flow may contain considerable salt that was applied to roads during the winter.

A more detailed discussion of the chemical quality of the streams during periods of overland flow follows the next section on ground water.

GROUND WATER

There are several ways for rain and melted snow to reach a stream and become streamflow, but the longest and slowest path is into and through the ground - the path followed by ground water. Thus, ground water, or more precisely its effluent or "runoff", is the predominant component of flow of perennial streams, large and small, most of the time. Therefore, ground water has the greatest single influence upon the chemical quality of water in streams. Overland flow is predominant in quantity only during and soon after either periods of substantial precipitation, or periods of major thaw in winter or spring, and it is only during these periods that the chemical quality of precipitation or overland flow is the principal influence upon the chemical quality of water in most streams.

Ground water and its chemical quality are discussed in detail in another of this series of reports on water in the Erie-Niagara Basin (LaSala, 1968). The discussion below is therefore brief. The effects of ground water upon the quality of water in streams are strongest during times of low streamflow (base flow), when there no longer remains in the streams any significant amount of water derived directly from precipitation or overland flow. A later section of this report describes the quality of water in streams at low flow.

Figure 1 shows some of the principal divisions of bedrock in the Erie-Niagara basin. The rocks are layered and dip to the south at about 40 feet per mile, and thus progressively younger rocks are exposed southward. For example, the northernmost unit is the Lockport Dolomite, which is overlain by the Camillus Shale. The Camillus, in turn, is successively overlain by the Bertie Limestone and Akron Dolomite and the Onondaga Limestone. The rocks are covered throughout most of the area by glacial deposits of till, clay, silt, sand, and gravel. These glacial deposits are thin, in many places less than 50 feet or even 10 feet thick, especially on hills and hillsides. In some valleys of the Appalachian uplands the deposits are much thicker and at places are as much as 600 feet thick.

As is shown in table 6 (from LaSala, Harding, and Archer, 1964), the quality of ground water in the Erie-Niagara basin varies considerably from one water-bearing unit to another, and even varies within the same unit. The latter variations in part result from the character of the

Table 6.--Summary of chemical analyses of ground water (Adapted from LaSala, Harding, and Archer, 1964)

Water-bearing units	Number of samples	Sulfate (SO_4) Maximum (ppm)	Sulfate (SO_4) Minimum (ppm)	Sulfate (SO_4) Median (ppm)	Chloride (Cl) Maximum (ppm)	Chloride (Cl) Minimum (ppm)	Chloride (Cl) Median (ppm)	Hardness as $CaCO_3$ Maximum (ppm)	Hardness as $CaCO_3$ Minimum (ppm)	Hardness as $CaCO_3$ Median (ppm)	Specific conductance Maximum (ppm)	Specific conductance Minimum (ppm)	Specific conductance Median (ppm)
Camillus Shale	12	1,950	134	1,100	2,520	7.0	214	2,780	319	1,410	9,010	597	2,370
Glacial deposits overlying Camillus Shale	7	1,250	244	623	650	6.8	84	1,690	413	851	4,270	960	1,650
Lockport Dolomite and Onondaga Limestone	8	469	31	104	334	2.2	29	838	200	333	1,750	504	936
Middle and Upper Devonian shale and sandstone	37	164	.0	19	120	1.0	17	621	52	236	1,290	187	523
Glacial deposits overlying Middle and Upper Devonian shale and sandstone	64	179	.0	18	123	.8	10	412	22	158	1,120	66	392

ground-water flow system, described by LaSala (1968). The minimum dissolved-solids content of ground water in the area is about 40 ppm, and the maximum is about 7,000 ppm. Concentrations of dissolved solids are generally between 55 and 80 percent of the values of specific conductance shown in table 6.

The most highly mineralized ground water occurs in the Camillus Shale (fig. 1), because this shale contains relatively soluble gypsum (calcium sulfate). Further downdip (southward from its outcrop belt) the Camillus Shale is thickly covered by overlying shale formations and contains beds of salt (sodium chloride). Ground water that has circulated down to the salt beds discharges to the downstream reach of Tonawanda Creek and locally increases the dissolved-solids content of water at shallow depth in the Camillus. Hardness, the soap-consuming and lime-depositing tendency of some waters, is caused by compounds of calcium and magnesium, which are very abundant in ground water from the Camillus Shale.

The Lockport Dolomite, Bertie Limestone, Akron Dolomite, and Onondaga Limestone also yield water that is high in dissolved solids. Their ground waters are hard, because the calcium and magnesium carbonate minerals composing the rock are fairly soluble. Most ground water in the Lockport has a high concentration of sulfate, which is dissolved from gypsum nodules that occur in the formation. Ground water high in sulfate occurs also in the western part of the outcrop belt of the Bertie, Akron, and Onondaga, where water is discharging upward from the underlying Camillus Shale.

Most of the central and southern parts of the Erie-Niagara basin are underlain by shale and some sandstone of Middle or Late Devonian age, which contain disseminated calcium carbonate and some thin limestone beds. Ground water that percolates downward through the rocks dissolves carbonate minerals, which make the water hard. Nevertheless, the ground water is considerably lower in dissolved solids than that in the northern part of the area. In some discharge areas, however, the shale and sandstone contain more highly mineralized water that may have circulated as deep as the Camillus Shale. Because of such circulation, the shale and sandstone may contain water exceptionally hard, and high in either sulfate or chloride, especially in areas along Lake Erie, near the outcrop of the Onondaga Limestone, and in a few valleys of the upland region.

Ground water from glacial deposits overlying the rock units shown in figure 1 has somewhat similar chemical characteristics to the underlying bedrock. Ground water that has circulated to only a shallow depth in the glacial deposits is usually less mineralized than water from the underlying bedrock, because the glacial deposits have been leached to a greater extent of some of the more soluble materials. However, ground water that has moved into the glacial deposits from the underlying bedrock generally is high in dissolved solids.

The relation of the principal streams to the underlying bedrock units is shown in figure 1. It is clearly evident from this figure and table 6 that the most highly mineralized ground water occurs in the northern part

of the region, and that the major streams affected by this mineralized water are Tonawanda Creek west of Batavia and Ellicott Creek. This situation will be emphasized again in a later section on the quality of water in streams at low flow.

CHEMICAL QUALITY OF STREAMS DURING PERIODS OF OVERLAND FLOW

The most rapid natural changes in the chemical quality of streams occur during the most rapid natural changes in rates of streamflow, which in turn are caused by heavy or moderate precipitation, by a significant thaw (melting substantial quantities of snow and ice), or by a combination of these effects. In most years a coincident rainfall and thaw occurs at least once in late winter or early spring, and the resulting streamflow is the largest, or among the largest, of each year.

It is at such times of high streamflow that the water in the stream is of the best quality, at least in terms of low mineralization, because most of the water consists of overland runoff, and there is only a small proportion of the more mineralized ground water in the stream. However, two disadvantages are associated with this situation: (1) the water is more likely to be turbid and contain higher concentrations of sediment than at other times; and (2) high flows usually occur during only a few weeks of the year, so that storage reservoirs would be required if the water were to be saved for later use.

This high-flow, low-mineral-content water represents one extreme of the range of water quality, and in order to define better this aspect of the water quality of streams, more than 150 samples of high-flow water were collected in the Erie-Niagara basin during March 1964. Analyses of these samples are summarized in table 5. Results of each analysis are given in table 17, along with some analyses of high-flow samples collected in March 1963. The location of each site is shown in plate 1, including the names of streams and places mentioned in the following paragraphs.

The climatic conditions and chemical results of sampling of high-flow streams on March 4, 5, and 9, 1964, are described briefly below. The local climatic data are listed in table 7. The analyses of overland flow samples collected during this same period have already been discussed.

Only a trace of precipitation at a few stations occurred in the area between the light snows of February 26 and 27 and the rain of the evening of March 4 and morning of March 5. During the period February 28 to March 5, a gradual warming trend occurred with air temperatures reaching into the forties to low sixties during the day and dropping to near freezing or below during the night. This caused daily melting and freezing of snow on the ground. At Buffalo.on March 1, there was 4 inches of snow on the ground with a water content of 1.2 inches; by March 3, the snow had all melted. At Colden the 19 inches of snow on the ground on March 1 had melted and compacted to 12 inches by March 4, and to a trace by March 9. At Arcade there was 7 inches on March 1, 6 inches on March 4, and 3 inches on March 9.

Stream stages showed a gradually rising trend with diurnal fluctuations resulting from daytime melting of the snow during the period prior to March 4. The rain of March 4 and 5 and the melting of snow caused sharp rises in the streams. The March 1 to 4 thaws produced runoff that initial diluting of ground water in the streams and some flushing of

Table 7.--Precipitation and air temperature preceding and during sampling of streams, at very high flows, February 26 to March 9, 1964 (U.S. Weather Bureau, 1964a and 1964b)

Daily precipitation, in inches (T=trace)

Date 1964	Arcade	Batavia	Buffalo Airport	Colden (1 mile north)	Gowanda	Linden	South Wales	Wales
Feb. 26	0.15	0.06	0.18	0.22	0.16	0.13	--	--
27	.02	.02	.02	.01	.06	.04	--	--
28	0	0	0	0	0	0	--	--
29	0	0	T	0	0	0	--	--
Mar. 1	0	0	T	T	0	0	0	0
2	0	0	0	0	T	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	.30	.04	0	.05	0	.47
5	.69	.30	.13	.80	.53	0	.36	.24
6	.76	0	.02	T	T	0	0	0
7	0	0	0	0	0	.20	0	0
8	.10	.13	.08	.13	0	0	0	.21
9	.33	.22	.52	.40	.27	.30	T	.26

Daily air temperature, in °F

Date 1964	Arcade Max.	Arcade Min.	Batavia Max.	Batavia Min.	Buffalo Airport Max.	Buffalo Airport Min.	Colden (1 mile north) Max.	Colden (1 mile north) Min.	Gowanda Max.	Gowanda Min.	South Wales Max.	South Wales Min.
Feb. 26	36	19	41	18	35	22	38	22	42	25	--	--
27	25	1	25	8	23	5	25	-4	29	9	--	--
28	34	-11	32	-3	29	4	31	-5	27	2	--	--
29	38	10	39	15	39	14	39	7	34	13	--	--
Mar. 1	--	--	40	30	41	31	38	28	40	28	40	27
2	52	30	50	32	46	32	50	26	44	33	41	27
3	56	26	57	29	56	36	60	28	54	34	52	26
4	49	29	54	37	53	38	50	30	62	35	59	29
5	--	--	59	30	58	29	55	30	60	45	54	30
6	40	23	40	25	40	27	41	25	55	27	55	22
7	54	32	54	31	51	30	50	27	53	30	47	26
8	39	24	42	28	39	29	38	26	54	29	54	26
9	55	30	57	30	48	29	55	31	58	33	50	24

Snowfall, in inches (T=trace)

Date	Arcade	Buffalo Airport	Colden (1 mile north)
Feb. 26	2.0	2.5	3.3
27	.3	.3	.5
28	0	0	0
29	0	T	0
Mar. 1	0	T	T
2	0	0	0
3	0	0	0
4	0	0	0
5	0	.4	.1
6	0	.2	T
7	0	0	0
8	0	1.0	1.5
9	0	T	.1

Snow on ground, in inches (T=trace)

Date	Arcade	Buffalo Airport	Colden (1 mile north)
Feb. 26	10	4	21
27	10	6	21
28	10	6	20
29	8	5	19
Mar. 1	7	4	19
2	7	3	17
3	6	T	14
4	6	T	12
5	5	T	8
6	5	T	6
7	4	0	4
8	4	0	2
9	3	0	T

surface areas. The runoff from the March 4-5 rain caused further dilution, and in most headwater areas the water-quality effect of ground water on the streams was insignificant at the time of sampling. In the downstream areas, however the effects of ground-water discharge on quality were still apparent, though subdued.

Table 8 is a summary by stream, basin, or section of the project area of some of the chemical characteristics of the water from streams during the period of high flow of March 4-9, 1964. Because the runoff of March 4-5 is likely to be equaled or exceeded annually, this chemical-quality condition might be expected at least annually. Some of the more significant interpretations, variations, or limitations of the analyses and additional available data on the chemical quality of high streamflow are discussed in the following section.

The chemical quality of surface water during the period of March 4-5 closely approached that of overland flow in the following streams: (1) tributaries of Cattaraugus Creek and Cattaraugus Creek itself upstream from Hosmer Brook, (2) small streams south of Eighteenmile Creek and draining directly into Lake Erie, (3) the headwaters and upstream tributaries of Cazenovia, Buffalo, Cayuga, Tonawanda, and Eighteenmile Creeks. These streams have in common either steep gradients or a low channel-storage capacity, or both. The larger streams with flatter gradients and greater channel storage had much higher specific conductances on March 4 and 5. Water of high specific conductance in the channels of these larger streams prior to the runoff apparently was not flushed rapidly out of the channels. Though the water with high specific conductance was considerably diluted, it strongly affected the quality of water in Cattaraugus Creek downstream from Arcade, in the lower reaches of Buffalo, Cazenovia, and in Cayuga Creeks, and in Tonawanda Creek downstream from Batavia.

The specific conductances of streams tributary to the Barge Canal and Tonawanda Creek just west of the Barge Canal generally were the highest of all in the Erie-Niagara basin. In this part of the study area there is a great deal of water stored in channels and swales. Rather than flushing such storage downstream, overland runoff may only dilute the accumulated concentration of dissolved solids.

The lower reaches of streams draining directly into Lake Erie were found to have relatively high specific conductances on March 9, 1964 (table 8, line 4). The quality of water in these streams was affected by a relatively high rate of ground-water discharge, because ground-water storage increased between March 4 and March 9. Ground-water discharge increases with ground-water storage, and greater amounts of overland flow are required to dilute the effects of ground water on stream quality during the seasonal period of ground-water recharge.

Table 8.--Some chemical characteristics of water from streams during the high-flow period of March 4-9, 1964

Stream basin, or section of project area	Approximate concentration or range: Specific conductance (micromhos)	Sulfate (ppm)	Chloride (ppm)	Hardness (ppm)	Remarks
Cattaraugus Creek, upstream from Hosmer Brook and most tributaries.	Generally 150, often 100	10 to 20	5	20 to 60	
Cattaraugus Creek, downstream from Hosmer Brook and a few of the larger tributaries.	200 to 260	--	--	--	Effects of ground water still significant in these streams.
Headwaters of small streams draining directly into Lake Erie, south of Eighteenmile Creek.	85 to 120	<25	<10	<60	
Lower reaches of small streams draining directly into Lake Erie, south of Eighteenmile Creek.	200 to 315	--	--	--	All samples collected Mar. 9. Ground water may have significant effect on the chemical quality at this time.
Headwaters of and most tributary streams of Eighteen-mile Creek and Buffalo River basin.	78 to 194 generally <150	<30	<10	<70	
Lower Buffalo River basin main stem streams.	>200	--	--	--	
Tonawanda Creek basin south of Genesee-Wyoming County line.	<200	<20	<10	<90	

Table 8.--Some chemical characteristics of water from streams during the high-flow period of March 4-9, 1964 (Continued)

Stream basin, or section of project area	Approximate concentration or range: Specific conductance (micromhos)	Sulfate (ppm)	Chloride (ppm)	Hardness (ppm)	Remarks
Tonawanda Creek tibutaries in Genesee County	200 to 300	25 to 35	5 to 25	60 to 140	
Tonawanda Creek downstream from Batavia	356 to 467	33 to 94	--	--	Strongly affected by residual ground water stored in channels and poorly drained areas.
Mud Creek basin	89 to 217	19 to 40	3.5 to 9.0	33 to 94	
North-flowing Tonawanda Creek tributaries, a few miles downstream from Murder Creek to Ellicott Creek.	148 to 1,000	--	--	--	Only four sites sampled. Possible pollution and inadequate dilution.
Tributaries to Tonawanda Creek and Barge Canal west of Barge Canal.	228 to 356	40+	18	100 to 130	
Headwaters of Ellicott Creek.	100	20	5	40	
Ellicott Creek between Mill Grove and Williamsville.	212 to 300	35 to 40	--	--	Effect of ground water still apparent.

CHEMICAL QUALITY OF STREAMS DURING PERIOD OF BASE FLOW

The concentration of dissolved solids in streams commonly is highest when streamflow is very small because the chemical quality is almost entirely the result of ground-water discharge. Low streamflows in the Erie-Niagara basin occur during much of the summer and early fall. Rates of evaporation are also highest in the summer and tend to increase even more the concentrations of dissolved solids.

The term base flow is applied in this discussion to those streamflow conditions when all or most of the flow is supplied by ground water. If there is no snow cover, base-flow conditions are quickly reestablished after a rainfall. For small streams with drainage areas of several square miles, ground water is the predominant source of the flow at all times except for just a few hours or days after a rainfall. In the lower reaches of the larger streams in the area, it may take a week or more after a rainfall before ground water again predominates in the streamflow.

During long periods of little or no precipitation, especially during the summer or early fall, the chemical quality of water in streams approaches that of the average shallow ground water of the area, with some modification by evaporation and deeper ground water. In order to determine the chemical quality of streams at base flow, about 200 samples were collected throughout the Erie-Niagara basin on July 2, 4, and 5, 1963. Locations of sampling sites are among those shown in plate 1. The analyses of all samples are given in table 18, and more detailed analyses of some samples are given in table 19. The analyses are summarized on the last two lines of table 5. The local weather conditions prior to and during the sampling are shown in table 9.

In the northern part of the study area (almost all the Tonawanda Creek basin and much of the immediately adjacent areas to the south), most of the samples were collected on July 2, 1963. At this time the smaller streams were under base-flow conditions. However, the main stem of Tonawanda Creek still contained some water from the small but intense rainfalls which occurred in the southeast corner of the area on June 28 and 29, and which affected the headwaters of Tonawanda, Buffalo, and Cattaraugus Creek basins. In the afternoon of July 2, a fairly general storm occurred over most of the Erie-Niagara basin, ranging from less than 0.5 inch of rain in the southwestern and central sections of the area to nearly 2 inches at Lockport. At this time sampling was stopped. Sampling was resumed on July 4, by which time most of the smaller streams had returned to base-flow conditions. Sampling on July 4 and 5 was mostly in the southern part of the area, the part which was least affected by the rain of July 2.

Table 9.--Precipitation and air temperature preceding and during sampling of streams at low flows, June 16 to July 12, 1963 (U.S. Weather Bureau, 1963a and 1963b)

Date 1962	Daily precipitation, in inches (T=trace) Arcade	Batavia	Buffalo Airport	Colden (1 mile north)	Gowanda	Linden	South Wales	Wales	Daily air temperature, in °F Arcade Max.	Arcade Min.	Batavia Max.	Batavia Min.	Buffalo Airport Max.	Buffalo Airport Min.	Colden (1 mile north) Max.	Colden (1 mile north) Min.	Gowanda Max.	Gowanda Min.	South Wales Max.	South Wales Min.
June 16	0	0	0	0	0	0	0	0	72	36	76	46	75	46	72	41	72	44	72	42
17	0	0	0	0	0	0	0	0	74	47	78	51	79	51	75	47	74	49	73	48
18	0	0	T	0	0	0	0	0	75	46	77	54	78	57	76	48	75	51	75	52
19	0	0	0	0	0	0	0	0	80	40	85	49	84	52	84	44	76	46	77	45
20	0	0	T	T	.01	0	0	0	66	52	83	67	75	51	76	59	84	65	83	50
21	.35	T	T	T	0	0	T	0	66	42	69	45	64	47	64	44	74	46	74	43
22	0	0	0	0	0	0	0	0	69	39	72	46	71	48	69	37	62	41	63	42
23	0	0	0	0	0	0	0	0	78	36	82	49	80	49	80	41	70	44	69	43
24	0	0	0	0	0	0	0	0	83	41	88	49	88	48	86	42	79	46	80	44
25	0	0	0	0	0	0	0	0	85	41	90	53	89	52	87	48	88	53	86	50
26	0	0	0	0	0	0	0	0	87	43	90	54	88	55	89	49	87	52	86	50
27	0	T	T	0	0	.10	0	0	88	50	92	65	90	63	91	54	89	62	90	57
28	.60	0	.05	T	0	0	0	2.26	90	55	91	65	91	62	90	59	91	62	91	56
29	.01	T	0	T	.50	0	0	0	84	62	92	69	91	60	89	63	94	67	93	64
30	.12	0	0	0	0	0	0	0	87	57	94	65	94	63	96	62	89	66	89	60
July 1	0	0	0	0	0	0	0	0	89	59	94	67	93	68	93	63	91	65	91	62
2	0	1.28	1.00	.73	0	0	0	1.49	89	62	92	65	87	65	92	63	91	71	91	65
3	a/ .46	0	0	T	0	a/1.10	a/ .01	0	77	51	72	53	72	55	70	49	91	57	91	52
4	0	0	0	0	0	0	0	0	72	40	77	48	74	51	71	39	70	48	70	44
5	0	0	0	0	0	0	0	0	76	45	78	56	79	58	75	43	75	52	74	53
6	0	0	0	0	0	0	0	0	77	39	77	46	78	47	78	42	77	46	78	42
7	.02	T	T	.38	0	0	0	.03	82	50	79	59	75	60	82	53	82	61	79	49
8	0	0	0	0	T	.04	.09	0	70	53	78	56	65	51	70	55	83	58	81	54
9	0	0	0	0	0	0	0	0	68	34	70	42	69	47	70	37	66	41	68	37
10	0	0	0	T	0	0	0	0	70	47	73	53	74	58	70	52	70	55	70	45
11	0	0	0	0	0	.20	0	0	78	52	81	58	81	60	80	54	72	56	70	52
12	0	0	0	0	0	0	0	0	84	48	85	55	86	55	86	50	81	54	80	51

a/ Rainfall occurred late on July 2, but was reported for following day when rain gages were serviced.

AREAL VARIATIONS

A regional picture of the water quality of small streams at base flow is shown in figure 5, based on specific conductance dterminations at about 200 sites. Dissolved-solids content for the corresponding areas shown on the map would be roughly two-thirds of the specific conductance. Figure 5 should be compared with figure 1, from which it is evident that the most mineralized water is discharged from the Camillus Shale, which contains gypsum (calcium sulfate). The next most mineralized water is discharged from the limestone and dolomite units which crop out south and north of the Camillus Shale. There are many local variations in water quality, corresponding mainly to local differences in composition of the rocks and glacial deposits, the character of the ground water flow system, and pollution.

The area as a whole may be divided into two main parts, with respect to chemical quality of water in streams: the Tonawanda Creek basin west of Batavia with its more mineralized water, and the remainder of the streams of the region with their lesser mineralized water. The following ranges of values in parts per million (from table 5, which in part is a summary of tables 18 and 19) are representative of most of the data obtained during the low-flow sampling of July 1963.

	Tonawanda Creek basin west of Batavia	Other parts of Lake Erie-Niagara area
Calcium	85 - 165 ppm	44 - 61 ppm
Sulfate	37 - 1,190 ppm	21 - 80 ppm
Chloride	22 - 107 ppm	5 - 53 ppm
Dissolved solids	410 - 717 ppm	170 - 296 ppm
Specific conductance	409 - 2,070 micromhos	286 - 599 micromhos
Hardness as $CaCO_3$	163 - 1,410 ppm	126 - 244 ppm
pH	7.3-7.9	7.0-8.3

Most of the streams in the Erie-Niagara basin contain water of the calcium-bicarbonate type; the exceptions are streams in the lower Tonawanda Creek basin, where the water is mainly of the calcium-sulfate type. Waters near the borders of this basin are mixtures of the two chemical types.

VARIATIONS ALONG A SINGLE STREAM

The natural chemical quality of a single stream at base flow may remain much the same throughout its length, or may change significantly at downstream points, depending on whether the chemical quality of most of the contributing ground water remains about the same or differs downstream. Examples of these situations are shown in figure 6. Note that there is relatively little change in chemical quality of Cattaraugus Creek throughout much of its length, a consequence of the fact that there is relatively little variation in the ground-water quality throughout the Cattaraugus Creek basin. The increased dissolved-solids content at Gowanda results

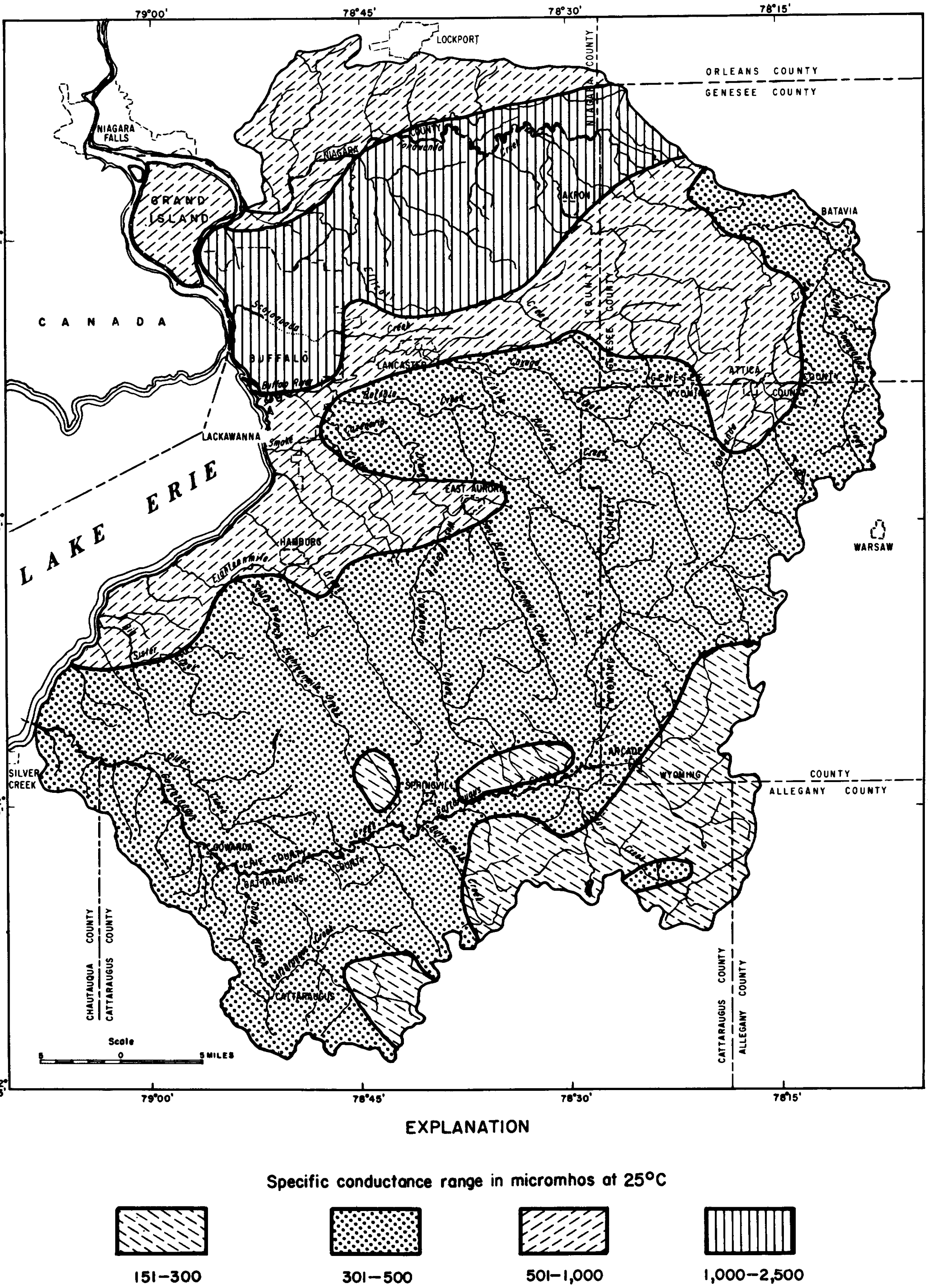
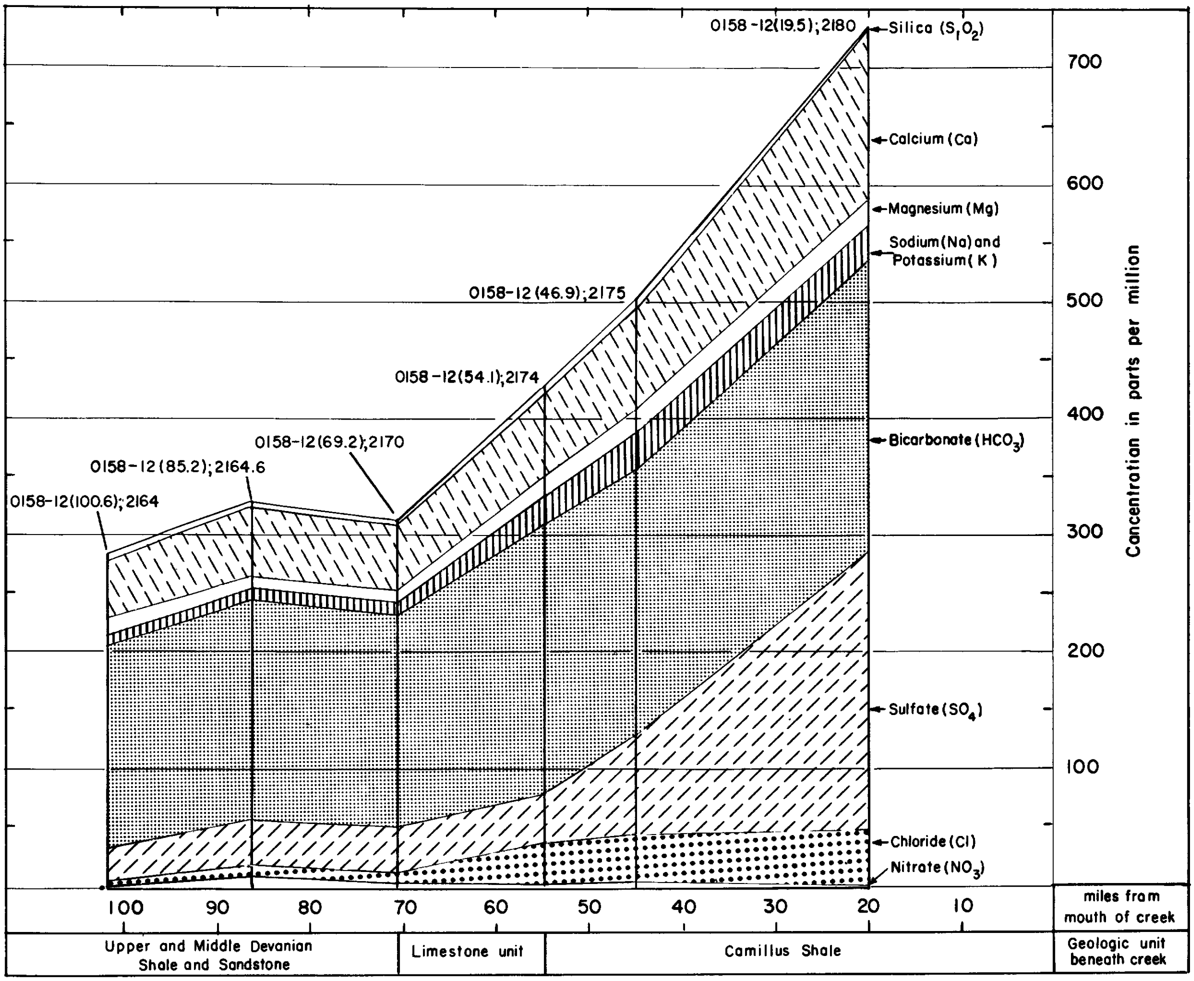
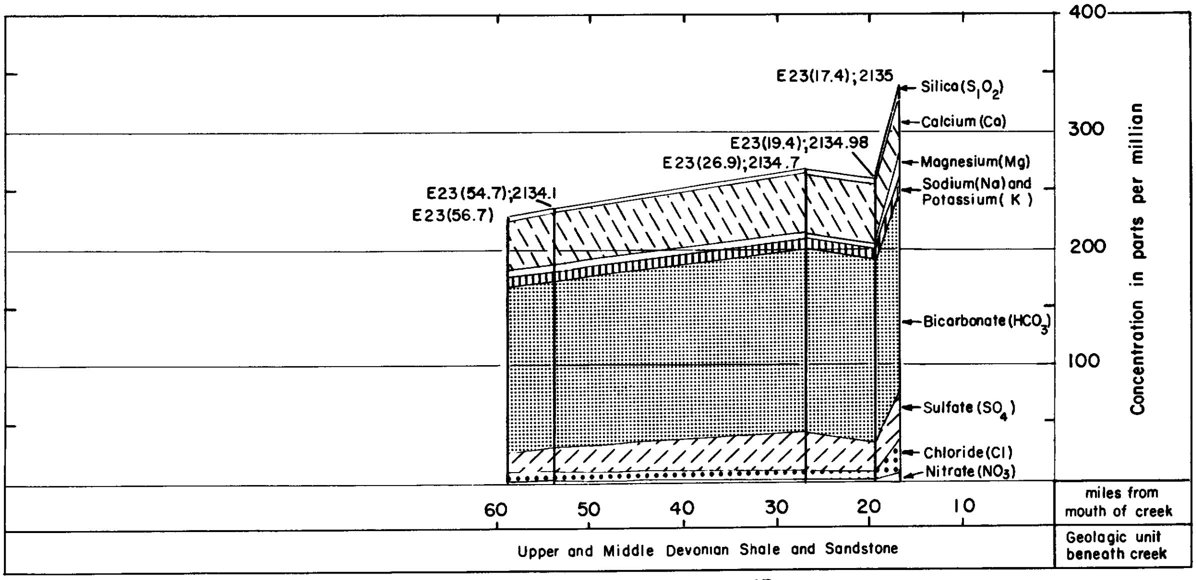


Figure 5.--Specific conductance of small streams at 75 to 95 percent flow duration.



TONAWANDA CREEK—JULY 2, 1963



CATTARAUGUS CREEK—JULY 2-5, 1963

Figure 6.--Variation in chemical quality of water in Cattaraugus and Tonawanda Creeks, July 2-5, 1963.

mainly from pollution. On the other hand, the graph of Tonawanda Creek shows significant chemical changes in a downstream direction, a result of associated changes in geology and ground water discussed in previous sections of this report. Note especially the increase in sulfate, as the stream flows across the area underlain by the Camillus Shale.

In addition to the similarities or differences along major streams referred to above, there are sometimes very noticeable local changes in chemical quality of small streams within short distances. South-flowing Dresser and Hyler Creeks in the Cattaraugus Creek basin (west of Arcade) are examples of this type of change. The streams were samples on July 4, 1963, upstream and downstream from the last major drop in elevation before entering Cattaraugus Creek. In these streams the following increases in both mineral concentrations (in parts per million) and discharge rates (cubic feet per second) were observed within a distance of 1.5 miles:

	Dresser Creek		Hyler Creek	
	Upstream	Downstream	Upstream	Downstream
Sulfate (ppm)	25	43	19	35
Hardness as $CaCO_3$(ppm)	137	180	75	134
Stream discharge (cfs)	0.148	0.272	0.224	0.417

To cause this increase in the mineral content of the stream water, the ground water which causes the increased flow at or near the downstream sampling sites on these streams must contain 50 to 70 ppm of sulfate, and 200 to 230 ppm of hardness. This more mineralized ground water probably has a longer and deeper path of underground travel to the streams than that of the ground water contributing to the upstream reaches. Also part of the path of travel was probably through rocks containing minerals more soluble than those found in rocks near the land surface.

CHANGE IN CHEMICAL QUALITY OF STREAMS WITH CHANGE IN FLOW

Previous sections of this report have shown the extremes of chemical quality of streams in the Erie-Niagara basin, and the reasons for the extremes. Thus, the dissolved-mineral content varies from generally low values, after heavy precipitation or a general thaw, to somewhat or considerably higher values during extended dry-weather periods. Between these extremes are many day-to-day variations which are not readily predictable without additional information on the chemical quality and flow of the streams. The main daily variations are caused by slowly but constantly changing rate of ground-water discharge and the irregular occurrence (both in time and in magnitude) of precipitation. In turn, the erratic occurrence of precipitation, along with such related factors as conditions of soil moisture, topography, vegetation, and air and water temperatures, determines the irregular rate of overland flow.

MEASURED VARIATIONS

Only two sites in the Erie-Niagara basin have been sampled for chemical quality on a daily or monthly basis -- Cattaraugus Creek at Gowanda and Buffalo Creek at Gardenville. Prior to 1963, daily sampling at these sites and at two others close to the area was done by the U.S. Geological Survey in cooperation with the New York State Department of Commerce, as summarized below:

Site	State site number USGS site number	Period of sampling	Chemical analyses in
Cattaraugus Creek at Gowanda	E23(17.4) 2135	Oct.1958 to Sept.1959 (daily)	Table 20
Buffalo Creek at Gardenville	E1(10.4) 2145	Oct.1961 to Sept.1962 (daily)	Table 21
Niagara River at Niagara Falls	0.58(19.6) 2160	Oct.1958 to Sept.1959 (daily)	Table 22
Erie (Barge) Canal at Lock 35, at Lockport	E230(0.8) 2196	Oct.1958 to Sept.1959 (monthly)	Table 23
		Oct.1961 to Sept.1962 (daily)	Table 23

The data for the Niagara River and for the Erie (Barge) Canal are tabulated in the back of this report.

At the daily sites, the specific conductance and pH of each daily sample are measured. During each calendar month the samples that have similar conductance and pH values on consecutive days are combined into a single sample for analysis of other chemical constituents. This procedure reduces the cost of analytical work but still produces accurate and representative information on the chemical quality of the stream.

The water in Cattaraugus Creek at Gowanda and in Buffalo Creek at Gardenville is of the calcium bicarbonate type. Graphs of daily specific conductance and daily streamflow for 1 year at these two sites are given in figures 7 and 8. As noted in previous sections, the specific conductance gives an indication of the dissolved-solids content. Often, the dissolved-solids content, in parts per million, is between 60 and 70 percent of the specific conductance in micromhos.

As is to be expected, the specific conductance tends to decrease when streamflow increases (high proportion of overland flow), and conversely, the specific conductance tends to increase when the streamflow decreases (high proportion of ground water). Most of the high streamflows are during the spring and during winter thaws, although some occur at other times of the year during unusually heavy rains; at almost all such times the specific conductance is reduced. During dry periods of the summer and fall, streamflow gradually decreases, and specific conductance gradually increases.

Note on the graph for Cattaraugus Creek (fig. 7), that variation in the specific conductance is considerable even during periods of low streamflow. This is, at least in part, the result of pollution, which adds to the variability of the stream quality. Some of the winter and spring variations in specific conductance of Buffalo Creek (fig. 8), such as on February 4, 1962, are thought to be due to "slug" pollution from road salt that is carried in snowmelt runoff, or is released by ice-jam breakup. Table 10 shows the frequency of occurrence of selected values of specific conductance at the Gowanda and Gardenville sites, for the 1 year of daily sampling.

Other chemical-quality data that are available for specific stream locations are listed in table 19. This table presents the complete analysis for more than 30 sites. Each site has 2 to 5 analysis and has usually been sampled at times of moderate or moderately low streamflow. These analyses generally represent the range of the most frequently occurring streamflow, and therefore the chemical quality that occurs the greater part of the time at each site. The greatest deficiencies of chemical data are in the moderately high range of streamflow.

COMPUTED STREAMFLOW QUALITY

Ordinarily streamflow is a mixture of ground water and overland flow. The volumes and proportions of ground water and overland flow in this mixture are continuously varying. If it can be assumed that ground water and overland flow of a given area have "distinctive quality" and that the

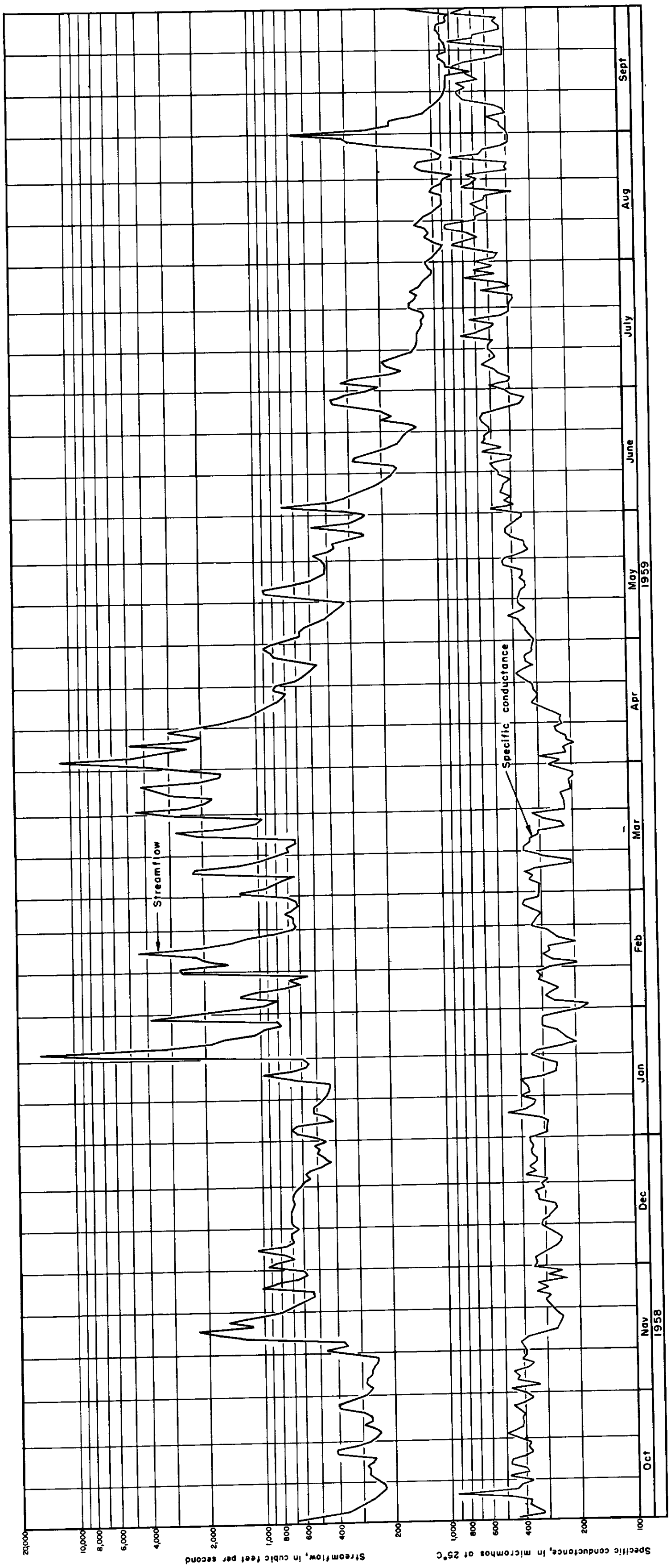


Figure 7.--Specific conductance and daily mean streamflow, Cattaraugus Creek at Gowanda, October 1, 1958 to September 30, 1959.

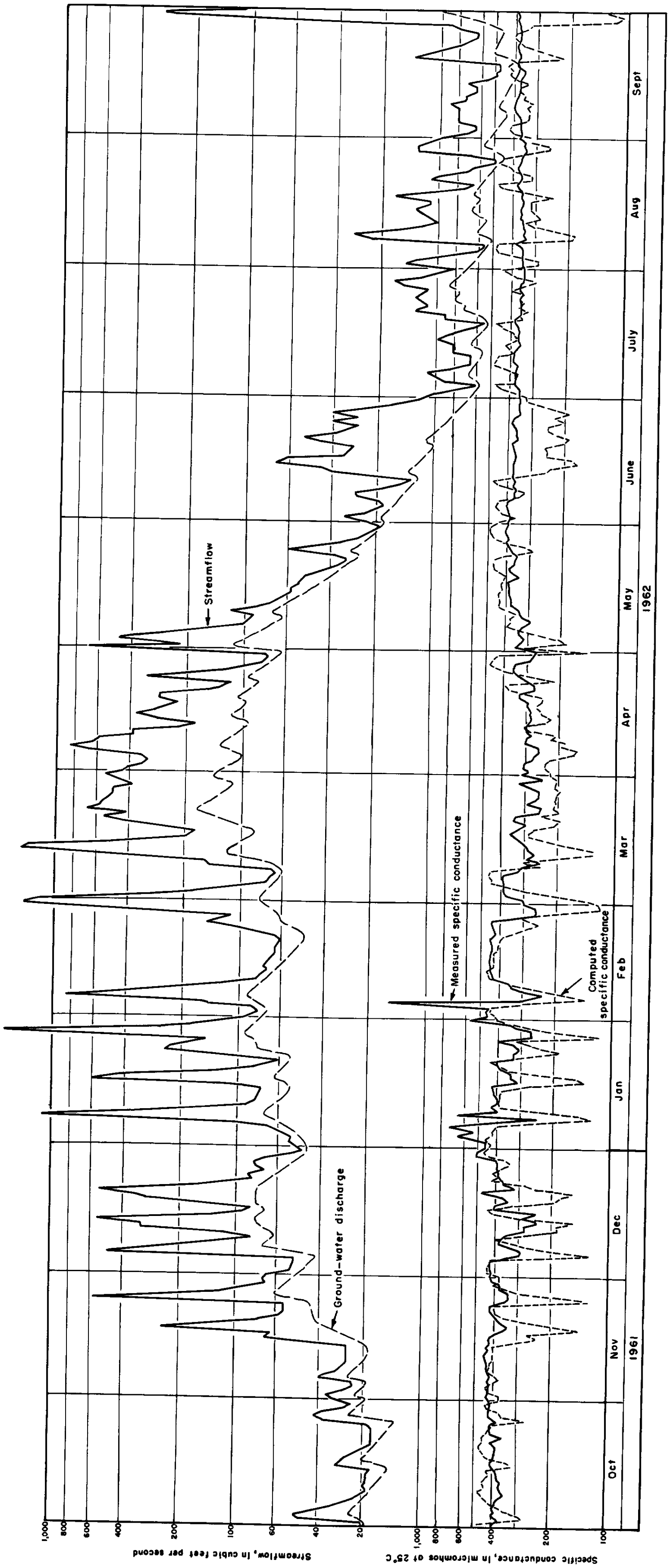


Figure 8.--Measured and computed specific conductance, measured streamflow, and estimated ground-water discharge, Buffalo Creek at Gardenville, October 1, 1961 to September 30, 1962.

Table 10.--Frequency of selected values of specific conductance, Cattaraugus Creek at Gowanda, October 1958 to September 1959, and Buffalo Creek at Gardenville, October 1961 to September 1962

Percent of time specific conductances of daily samples were equal to or less than that shown

BY "PERCENT-OF-DAYS" INTERVALS

Percent of days	Cattaraugus Creek at Gowanda (micromhos)	Buffalo Creek at Gardenville (micromhos)
1	190	250
10	242	290
25	300	330
50	360	360
75	440	390
90	568	430
99	830	540

BY "MICROMHOS" INTERVALS

Micromhos	(Percent of days)	(Percent of days)
200	3	--
250	--	1
300	25	14
350	--	38
400	65	80
450	--	96
500	82	97
550	--	99
600	93	--
700	96	--
800	98	--

chemical quality of the streamflow in that area depends on the relative proportion of each, then the chemical quality of the streamflow can be determined by measuring the quality and quantity of each of the two components. Meinzer and Stearns (1929, p. 111-113) intimated that such assessment was logical.

Specific conductance or many other chemical-quality parameters can be computed for some streams with an accuracy of about 5 to 20 percent, by using the types of data found in this report and the Survey's reports on streamflow (Harding and Gilbert, 1968) and ground water (LaSala, 1968). Computations in this report were made by use of the following formula:

$$S_q \times S_c = (G_q \times G_c) + (O_q \times O_c)$$

which becomes:

$$S_c = \frac{(G_q \times G_c) + (O_q \times O_c)}{S_q}$$

where S_q = streamflow

S_c = streamflow quality characteristic (micromhos or ppm)

G_q = ground-water discharge

G_c = ground-water quality characteristic (micromhos or ppm)

O_q = overland-flow discharge

O_c = overland-flow quality characteristic (micromhos or ppm).

Ground-water discharge is estimated by use of a ground-water rating curve based on correlations of streamflow data with water levels in observation wells. The ground-water and overland-flow quality characteristics are those chemical or chemical-related values obtained, respectively, during periods of base flow (table 18) and overland flow (table 16) or very high streamflow (table 17).

The accuracy of these methods of computation is obviously limited by how accurately and how well the collected samples represent the characteristics of the stream; do the chemical-quality, streamflow, and ground-water discharge data used in the computation typify actual conditions? Furthermore, the assumption of typical conditions requires relative uniformity of the climatic, physical, and geologic environments of the stream basin upstream from the point for which the computations are being made. The larger the upstream basin, the less uniform the conditions. Therefore, the computations are more likely to be valid for small stream

basins than for large ones. In a larger basin, for example, a rainfall producing a certain streamflow may occur mainly in a part of a basin that has low dissolved-mineral characteristics; and a second rainfall may produce the same streamflow at the same measuring site, but the rainfall may occur mainly over a different part of the basin, a part having higher dissolved-mineral characteristics.

Another factor to be kept in mind with respect to computations using these kinds of data is that the chemical samples are so-called grab samples, that is, sampled at a particular instant in time, whereas the type of streamflow data used in each computation is the mean flow for an entire day. At times of relatively constant flow, the difference between a grab sample and the mean sample would usually not affect the accuracy of the computation; but, at times of variable flow or soon after release of polluted matter in a stream, the selection of the representative values for quality and quantity are much more difficult, and accuracy may be somewhat low. A grab sample taken during a period of rapidly changing streamflow likewise may not be representative of the average daily quality.

SPECIFIC CONDUCTANCE, DAILY VALUES

Computations of specific conductance, of the type described in the preceding section, were made for the following sites, and graphs of the data are shown in the figures indicated, each for the 12-month period ending September 30, 1962, except Cattaraugus Creek which is for the year ending September 30, 1964:

Cattaraugus Creek near Arcade (drainage area, 78.4 square miles)	Figure 9
Buttermilk Creek near Springville (drainage area, 29.3 square miles)	Figure 10
Little Tonawanda Creek at Linden (drainage area, 22.1 square miles)	Figure 11
Buffalo Creek at Gardenville (drainage area, 145 square miles)	Figure 8

The first three sites noted above represent small drainage areas, each of which has a relatively uniform hydrologic environment; the fourth site represents a larger area and a more varied physical and geologic environment.

The following specific-conductance values were chosen for the overland-flow and ground-water quality characteristics:

	Specific conductance	
	Overland flow (micromhos)	Ground water (micromhos)
Cattaraugus Creek near Arcade	85	300
Buttermilk Creek near Springville	80	250 (for 16 cfs or more) to 620 (for 1 cfs or less)
Little Tonawanda Creek at Linden	150	420
Buffalo Creek at Gardenville	95	500

Chemical data for Buttermilk Creek indicate a progressive increase in the dissolved-solids content of discharging ground water as the rate of ground-water discharge decreases. This change in quality is believed to be explained by the creek receiving a fairly constant, but small, discharge of deeply circulating ground water that is high in dissolved solids. As the discharge of shallow-circulating ground water that is lower in dissolved solids decreases, the overall concentration in the discharging ground water increases. A straight-line relationship was assumed between the specific conductance of 250 micromhos at 16 cfs and 620 micromhos at 1 cfs.

The applicability of this method of computation and of the data shown above were checked by comparing computed values with measured values for each site. These comparisons are shown in table 11. The average difference between the computed and measured values at the Arcade site was 24 micromhos (or 12 percent), at the Springville site 14 micromhos (or 5 percent), and at the Linden site 18 micromhos (or 6 percent). At the Springville site, no high-flow samples with the necessary discharge data were available for comparison with the computed values. These relatively small differences indicate that the method of computation is valid for these three sites, at least for low and moderate flows, and that representative values were chosen for the specific conductance of the overland flow and of ground water. The specific conductance graphs (figs. 9, 10, and 11) for these sites are probably substantially correct for periods of little variation in streamflow, but the accuracy is no doubt diminished during periods of sharply changing streamflow.

The site on Buffalo Creek at Gardenville and a site on Cattaraugus Creek at Gowanda are the only two places in the Erie-Niagara basin for which daily measured conductance values are available for a full year. Because of the lesser effect of pollution, the Gardenville site was chosen for computation of daily conductance values to be compared with the measured values. The measured and computed conductances are shown in figure 8. Table 11 compares the differences between measured and computed values of specific conductance. The agreement of the measured

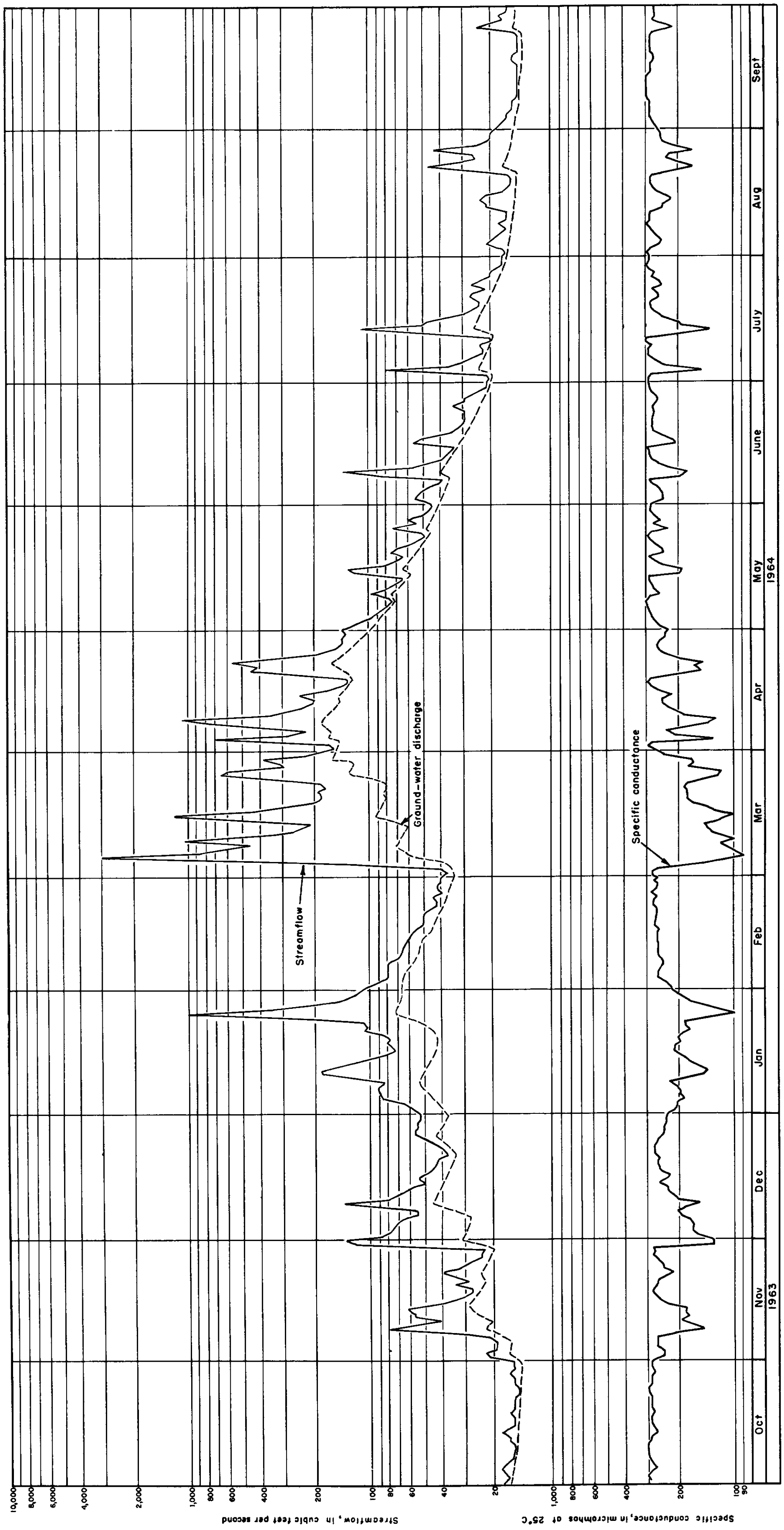


Figure 9.--Computed specific conductance, measured streamflow, and estimated ground-water discharge, Cattaraugus Creek near Arcade, October 1, 1963 to September 30, 1964.

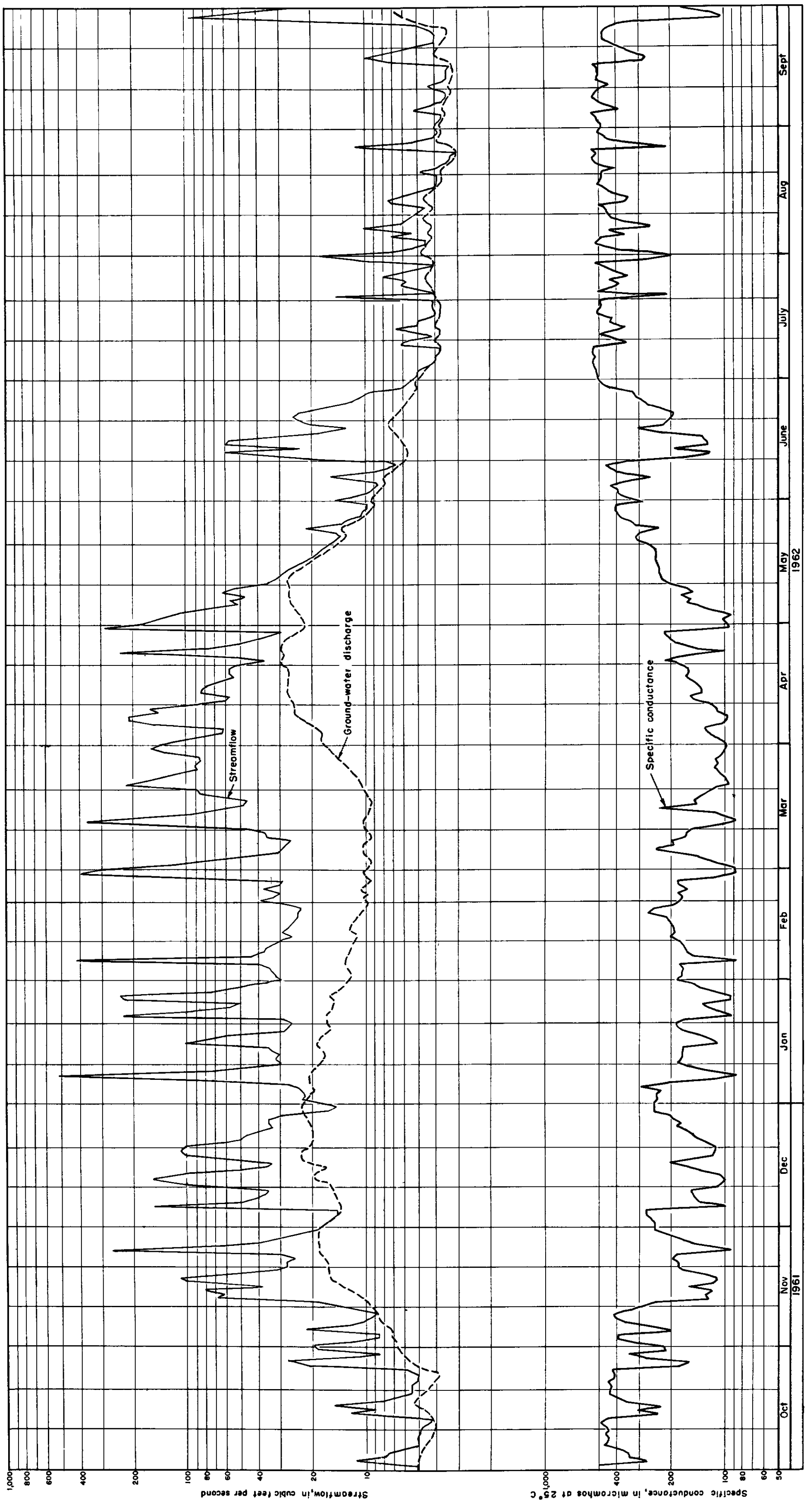


Figure 10.--Computed specific conductance, measured streamflow, and estimated ground-water discharge, Buttermilk Creek near Springville, October 1, 1961 to September 30, 1962.

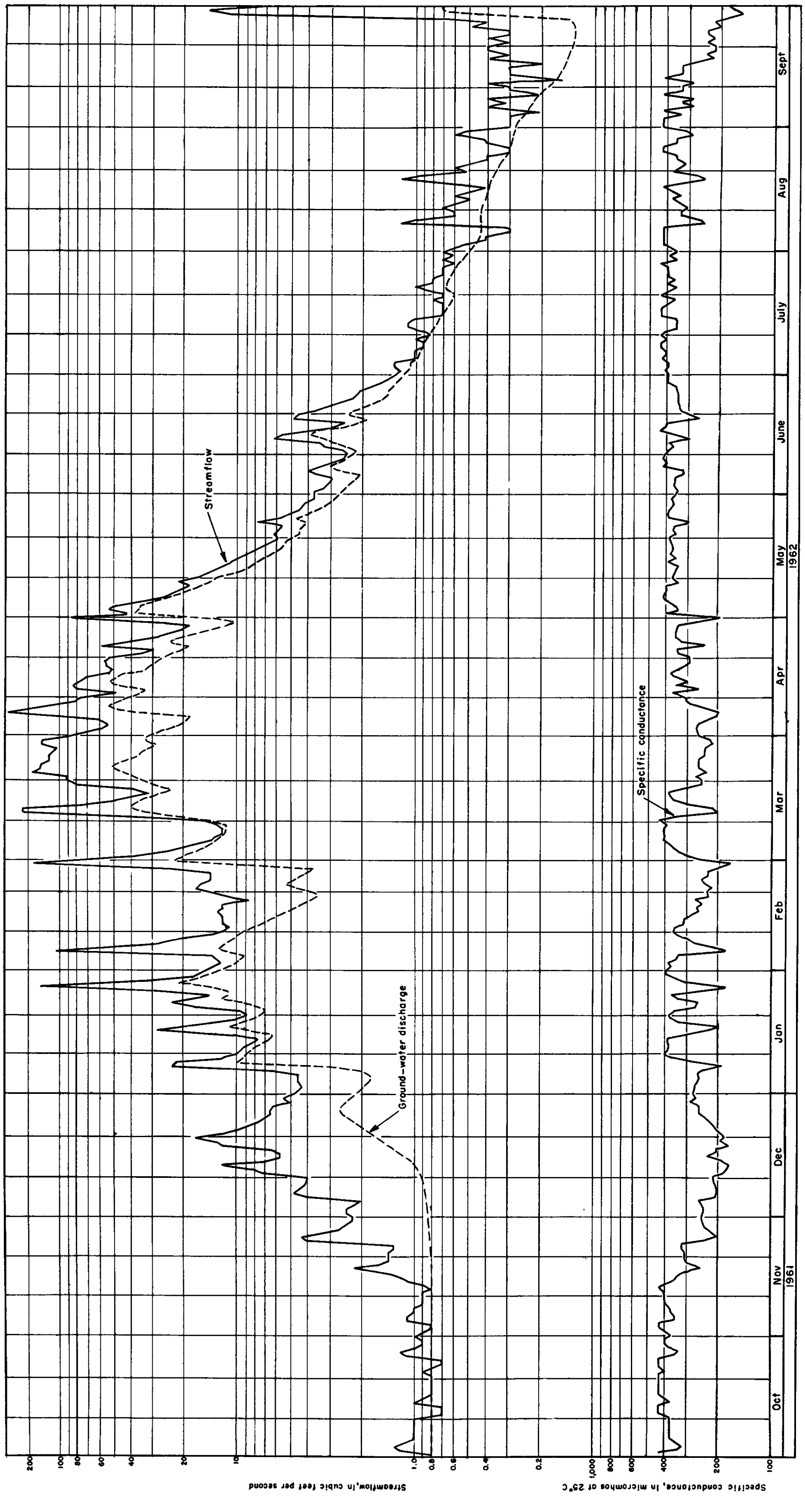


Figure 11.--Computed specific conductance, measured streamflow, and estimated ground-water discharge, Little Tonawanda Creek at Linden, October 1, 1961 to September 30, 1962.

Table 11.--Comparison of computed values of specific conductance with measured values at each of four stream sites

Date of sample	Discharge: Instantaneous streamflow (cfs)	Discharge: Overland flow (cfs)	Discharge: Ground water (cfs)	Specific conductance: Ground water (micromhos)	Specific conductance: Streamflow computed (micromhos)	Specific conductance: Streamflow measured (micromhos)
			Cattaraugus Creek near Arcade			
3-20-63	848	648	200	--	136	170
4-17-63	102	6	96	--	287	278
5- 7-63	70	5	65	--	285	288
7- 2-63	30.5	7.5	23	--	247	295
3- 5-64	3,270	3,215	55	--	98	126
			Buttermilk Creek near Springville			
5-18-62	15.7	.7	15	260	252	245
10- 8-62	4.8	2.5	2.3	580	320	334
2- 4-63	a/19	a/3	16	250	b/223	233
5- 7-63	15.7	3	15	260	238	216
7- 4-63	4.99	1.39	3.6	560	426	445
			Little Tonawanda Creek at Linden			
5- 8-63	9.9	4.0	5.6	--	303	348
7- 2-63	1.84	.4	2	--	420	420
3- 5-64	923	887	36	--	160	152
			Buffalo Creek at Gardenville			
6-20-51	27	7	20	--	395	339
8-13-56	36	25	11	--	218	347
4-10-61	1,110	1,010	100	--	131	210
8-21-61	32	17	15	--	285	378
1- 6-62	160	113	47	--	214	427
1- 7-62	1,030	982	48	--	114	242
1- 8-62	256	208	48	--	171	628
2- 4-62	180	132	48	--	203	c/1,580
5- 8-63	118	56	62	--	308	383
7- 5-63	21.3	11.3	10	--	285	359
4-16-64	122	72	50	--	261	334

a/ Mean daily discharge.
b/ Mean conductance.
c/ This sample is believed to be influenced by local pollution and not representative of the stream.

and computed values is poor. The greatest difference between measured and computed conductance occurred when overland flow into the stream exceeded ground-water discharge; generally the measured values were higher. Conversely, when ground-water flow was predominant, measured values generally were less than the computed values.

When fixed values of specific conductance are chosen to describe ground-water flow (500 micromhos in this case) and overland flow (95 micromhos), the method of computation thereby sets the upper and lower limits of specific conductance corresponding respectively to the lowest and highest streamflow. For Gardenville, the maximum possible computed value of 500 micromhos was exceeded by measured values 9 times; ground water was the predominant component of flow 7 of those 9 times.

There are several factors which affect the quality of Buffalo Creek and its tributaries, but these factors are not taken into account in the computations. The Buffalo Creek basin is large and of varied geology. The stream before reaching Gardenville passes from an area of better quality ground water to one of poorer quality. Furthermore, chemical quality of precipitation and overland flow varies with variations in the air pollution over the basin; usually, the upstream part of the basin is less polluted than the downstream part. The 5-mile reach upstream from the sampling site receives little inflow from tributaries or ground water. This reach is a series of pools and riffles in which time of travel is slow enough to allow for the homogeneous mixing of overland runoff and ground water. This slow mixing cuts down on the day-to-day variations of stream-water quality at the sampling site. Because of all these varying factors, Buffalo Creek is not appropriate for computing daily chemical-quality values by the foregoing method. However, all the water that enters the basin must eventually be discharge and all the components from various parts of the basin will tend towards some average value. Eventually, it may be possible to compute values representative of longer periods, perhaps monthly mean values.

Table 12 compares computed and measured daily values of specific conductance. The values agree with an average of 20 percent. If the qualities of discharging ground water and of overland runoff were known more precisely, the computation of specific conductance would be more accurate. The averages by months of the differences between computed and measured daily specific conductance are in close enough agreement to suggest that, even with present data, computations of chemical quality can be made on a monthly basis with sufficient accuracy to be useful to water users.

Table 12.--Differences between measured and computed daily values of specific conductance, Buffalo Creek at Gardenville, October 1961 to September 1962, by months

Month	Difference in micromhos			Difference in percent of measured value		
	Minimum	Maximum	Average	Minimum	Maximum	Average
October 1961	9	114	60	2	32	16
November	4	226	61	1	64	16
December	2	329	67	0	69	19
January 1962	4	483	103	1	77	25
February	8	187*	64*	2	60*	19*
March	37	159	87	4	55	28
April	4	167	72	1	58	25
May	10	139	64	3	43	18
June	15	200	96	5	55	27
July	0	116	42	0	35	12
August	1	160	69	0	47	20
September	7	272	67	2	72	18
Water year	0	483*	71*	0	77*	20*

* Does not include sample collected February 4, 1962.

RELATION OF SPECIFIC CONDUCTANCE TO DISSOLVED-SOLIDS CONTENT, SULFATE, AND CHLORIDE

Specific conductance is easily measured either in the field or in the laboratory and is a parameter commonly determined, even to the exclusion of other chemical parameters. As may have been apparent, the preceding discussion was largely concerned with specific conductance, because specific conductance was measured in a large number of samples and was the only parameter for which at least one full year of daily values was available for comparison with daily computed values.

Data on specific conductance are most useful if they can be related to other chemical parameters. In this light, the concentrations of dissolved solids, sulfate, and chloride determined in samples were plotted against corresponding specific conductance, and some relationships were found. Figures 12, 13, and 14 are graphs correlating dissolved solids, sulfate, and chloride with specific conductance in one basin (Buffalo Creek upstream from Gardenville) and in the two major divisions of the Erie-Niagara basin -- the highly mineralized part, underlain by the Camillus Shale, and the much larger but less mineralized part, underlain by less soluble rocks and minerals. A generalized map of these rock units is shown in figure 1. These correlation graphs then may be used to estimate the concentration of dissolved solids, sulfate, and chloride that corresponds to a value of specific conductance.

The graphs are most reliable in the middle and lower ranges of values and less so for the upper values. The chemical data upon which the lines are based are contained in tables 17, 18, and 19. Note that on the graph for the area underlain by the Camillus Shale (fig. 13), each line "breaks" to the right at a specific conductance of 800 micromhos, because each graphed point had a higher chemical concentration-to-conductance ratio above 800 micromhos than below. Below 800 micromhos the graph lines were fairly well defined by the plotted points (not shown); above 800 micromhos the graph lines were poorly defined, and the chemical type of water was more likely to vary. This variation occurs because surface water having a conductance greater than 800 micromhos contains two types of discharged ground water in varying proportions: (1) ground water high in sulfate that has circulated only to shallow depth, and (2) deeply circulated ground water high in chloride.

DURATION CURVES OF SPECIFIC CONDUCTANCE

The variations in the quality of streamflow over a period of time can be summarized by duration curves. Figures 15, 16, 17, and 18 present chemical-quality duration curves that show the percent of time the specific conductance was equal to or less than the specific conductance values shown on the graph. The duration curves for streamflow were obtained from the Erie-Niagara basin report on streamflow by Harding and Gilbert (1968),

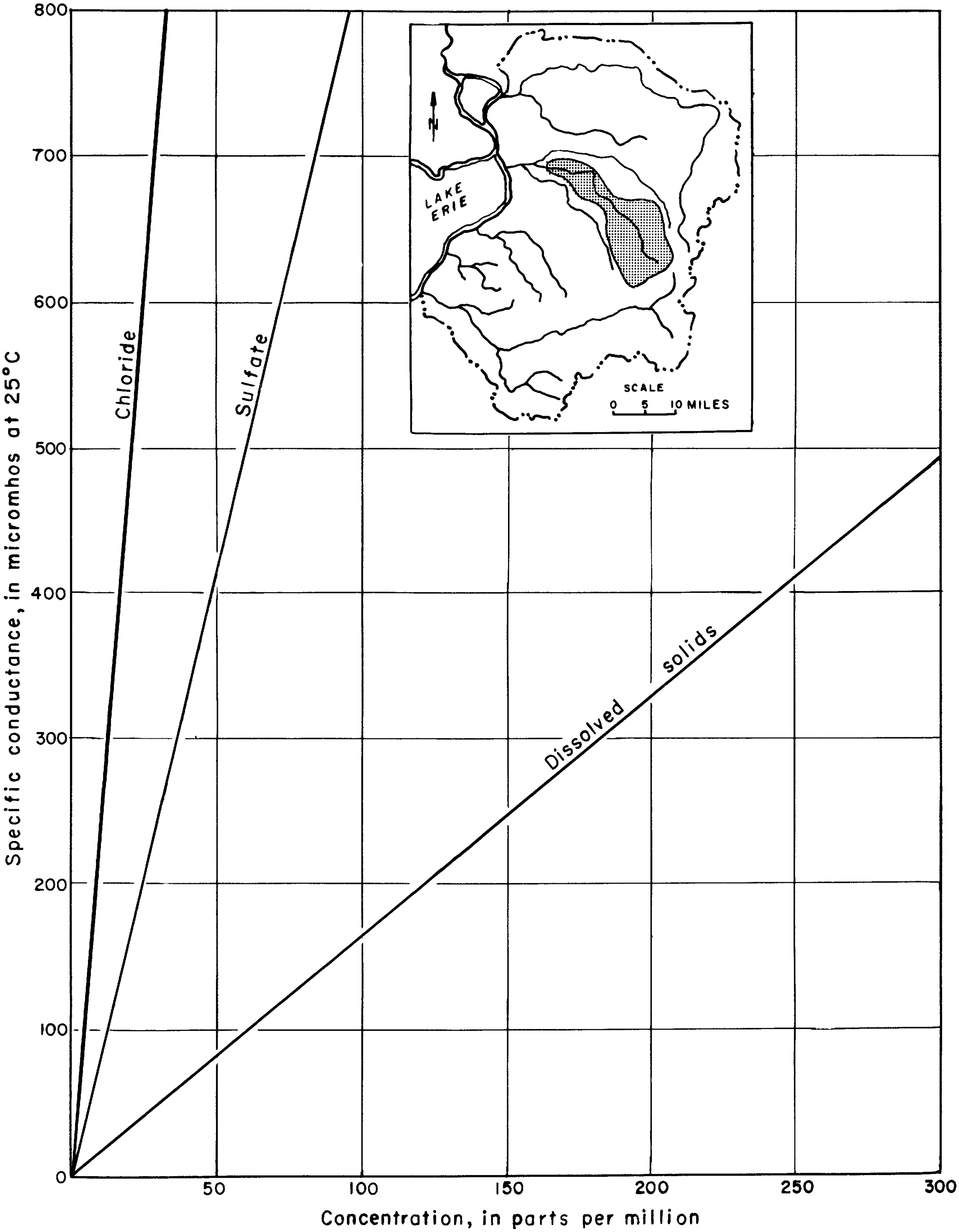


Figure 12.--Relation of specific conductance to selected chemical parameters of water in Buffalo Creek at Gardenville, October 1961 to September 1962.

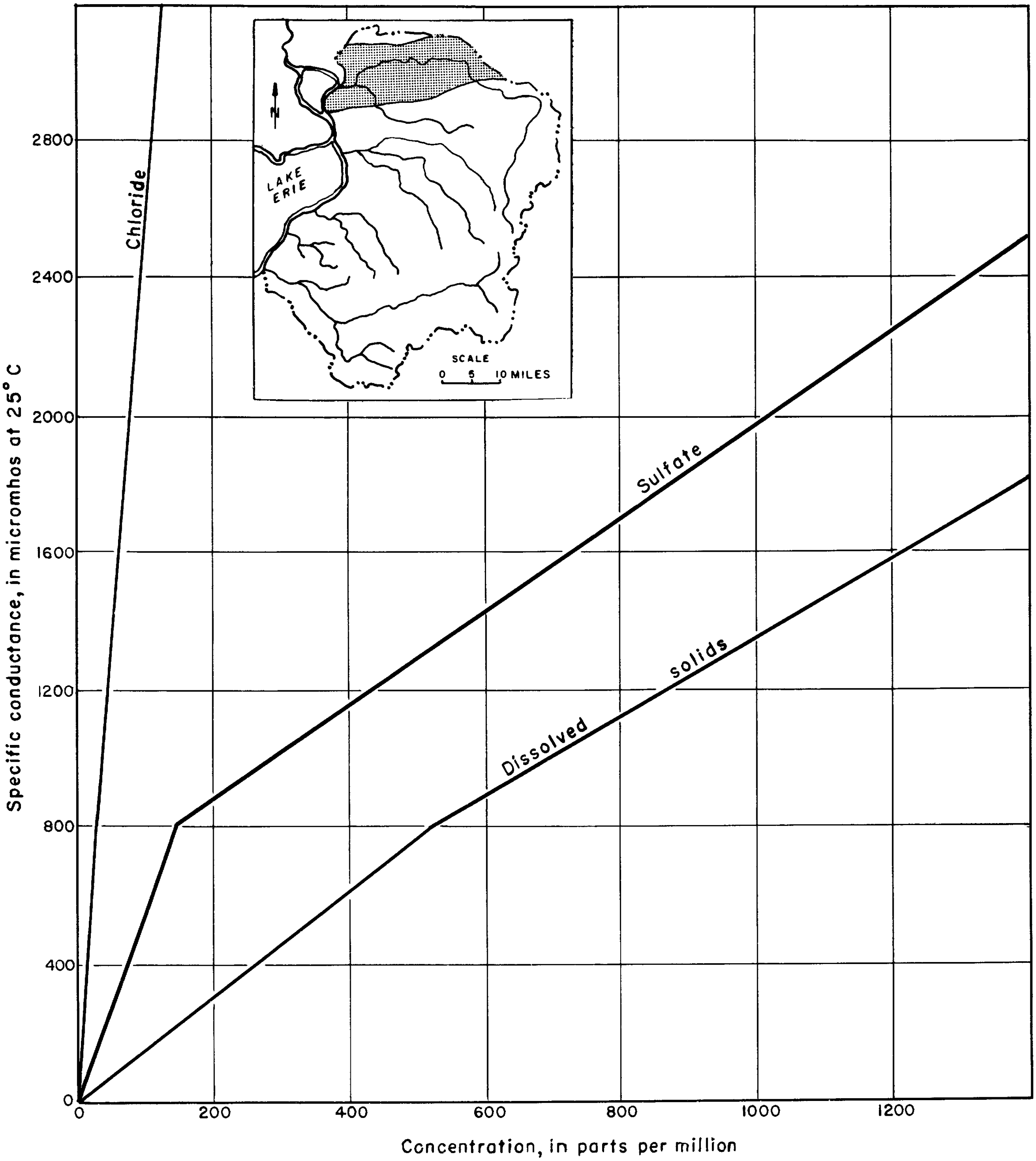


Figure 13.--Relation of specific conductance to selected chemical parameters of water in streams in the part of the Erie-Niagara basin where the Camillus Shale crops out.

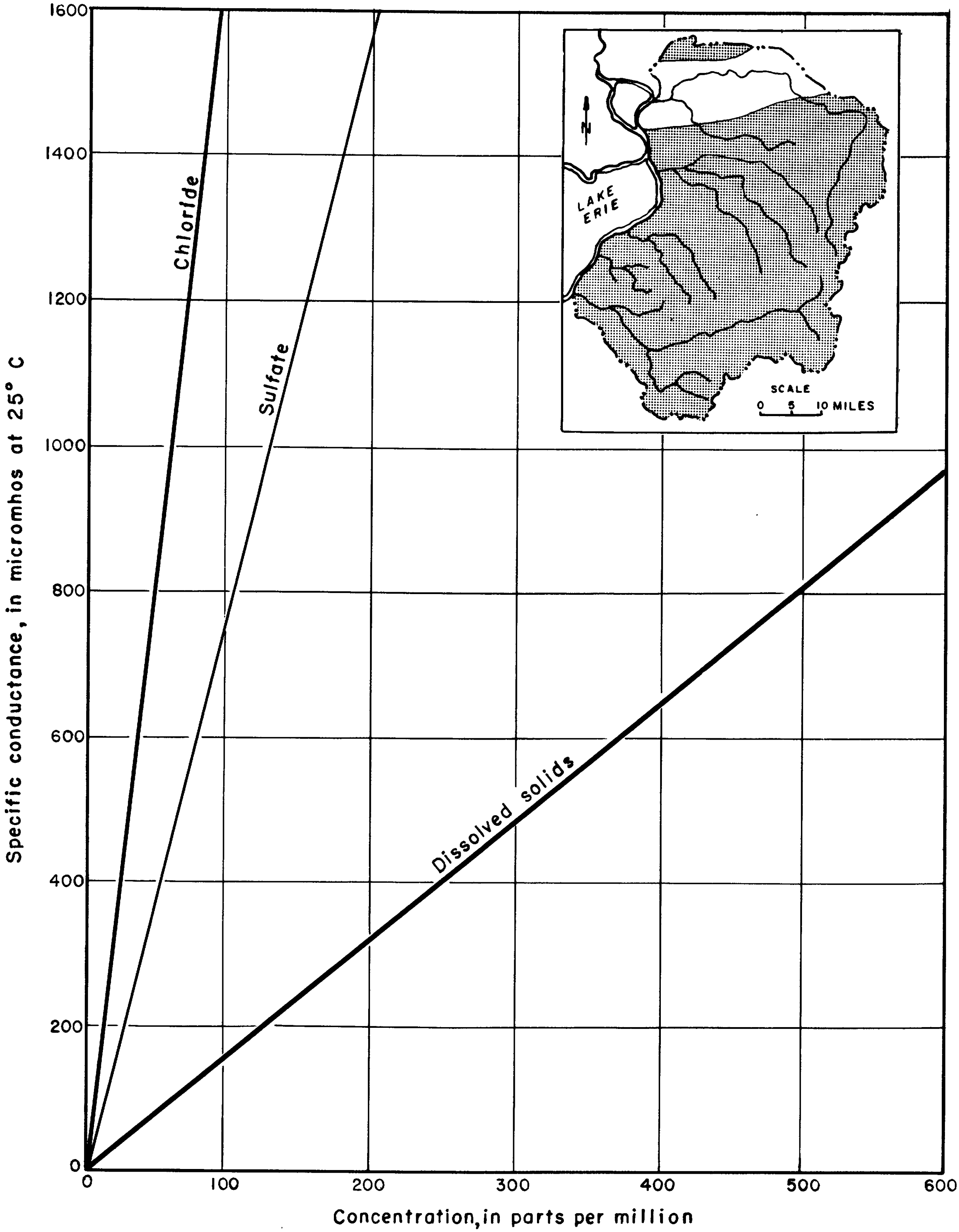


Figure 14.--Relation of specific conductance to selected chemical parameters of water in streams in the Erie-Niagara basin, except the area where Camillus Shale crops out.

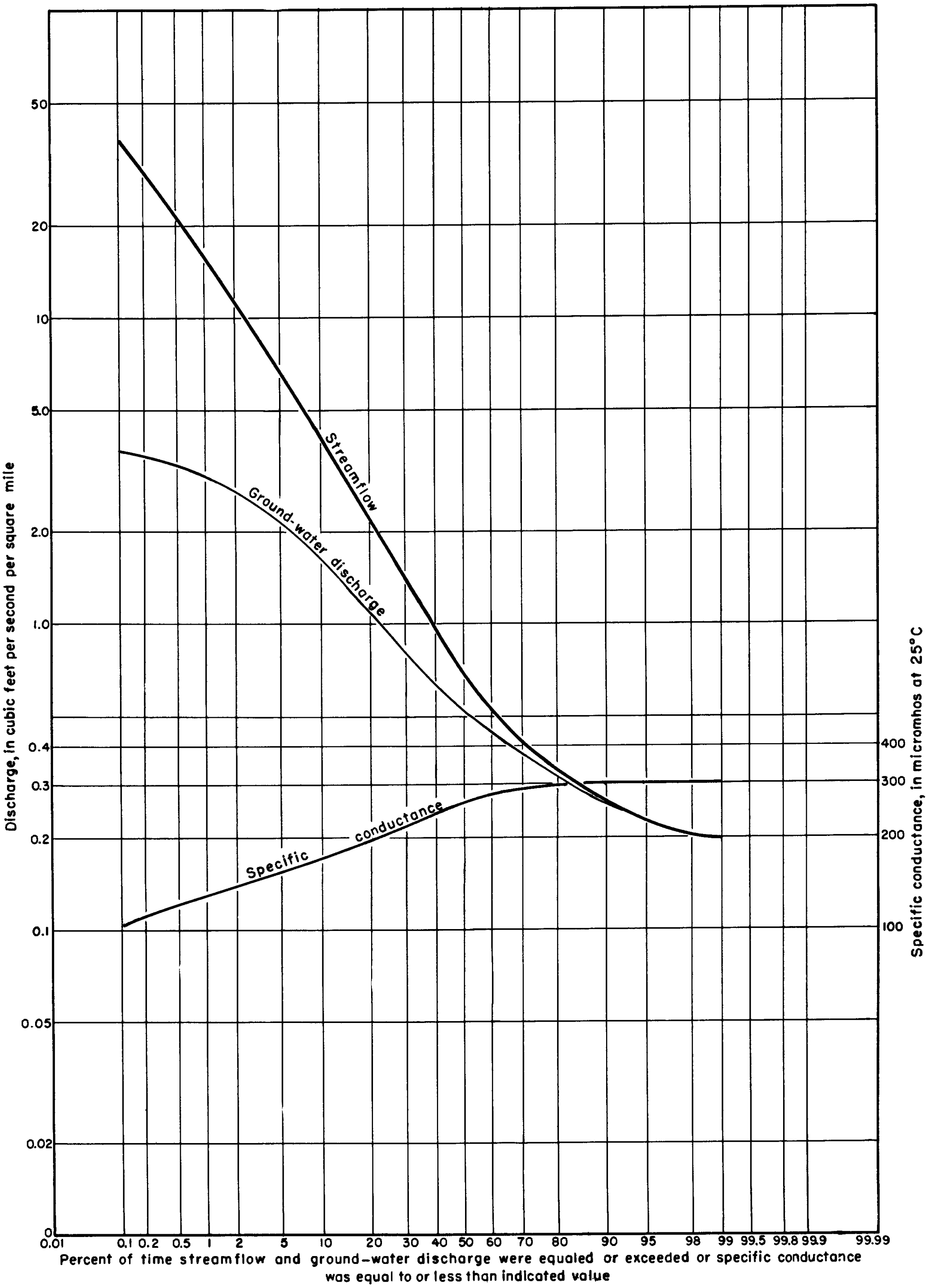


Figure 15.--Duration curves of streamflow, ground-water discharge, and specific conductance, Cattaraugus Creek near Arcade, adjusted to 1931-60 base period.

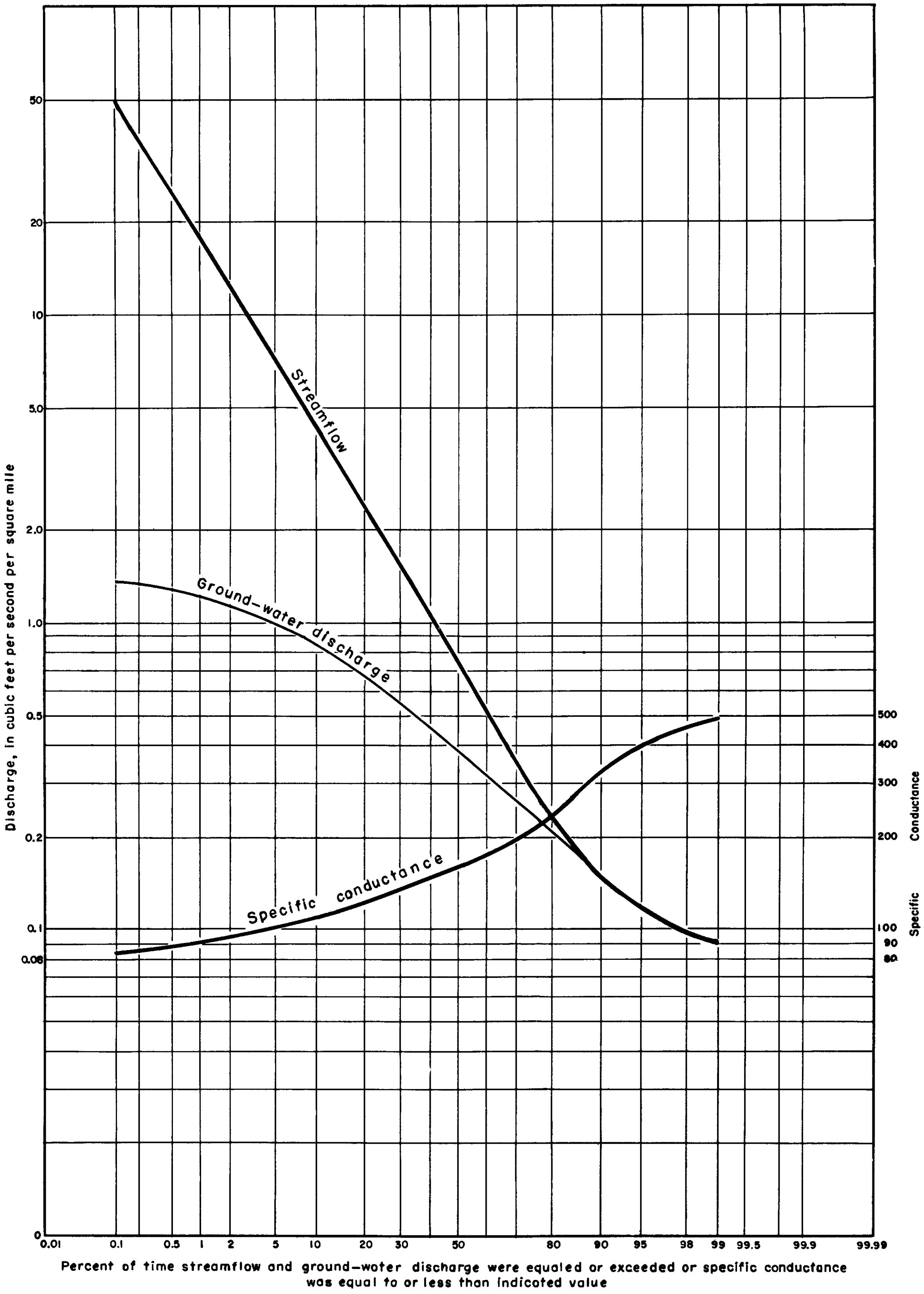


Figure 16.--Duration curves of streamflow, ground-water discharge, and specific conductance, Buttermilk Creek near Springville, adjusted to 1931-60 base period.

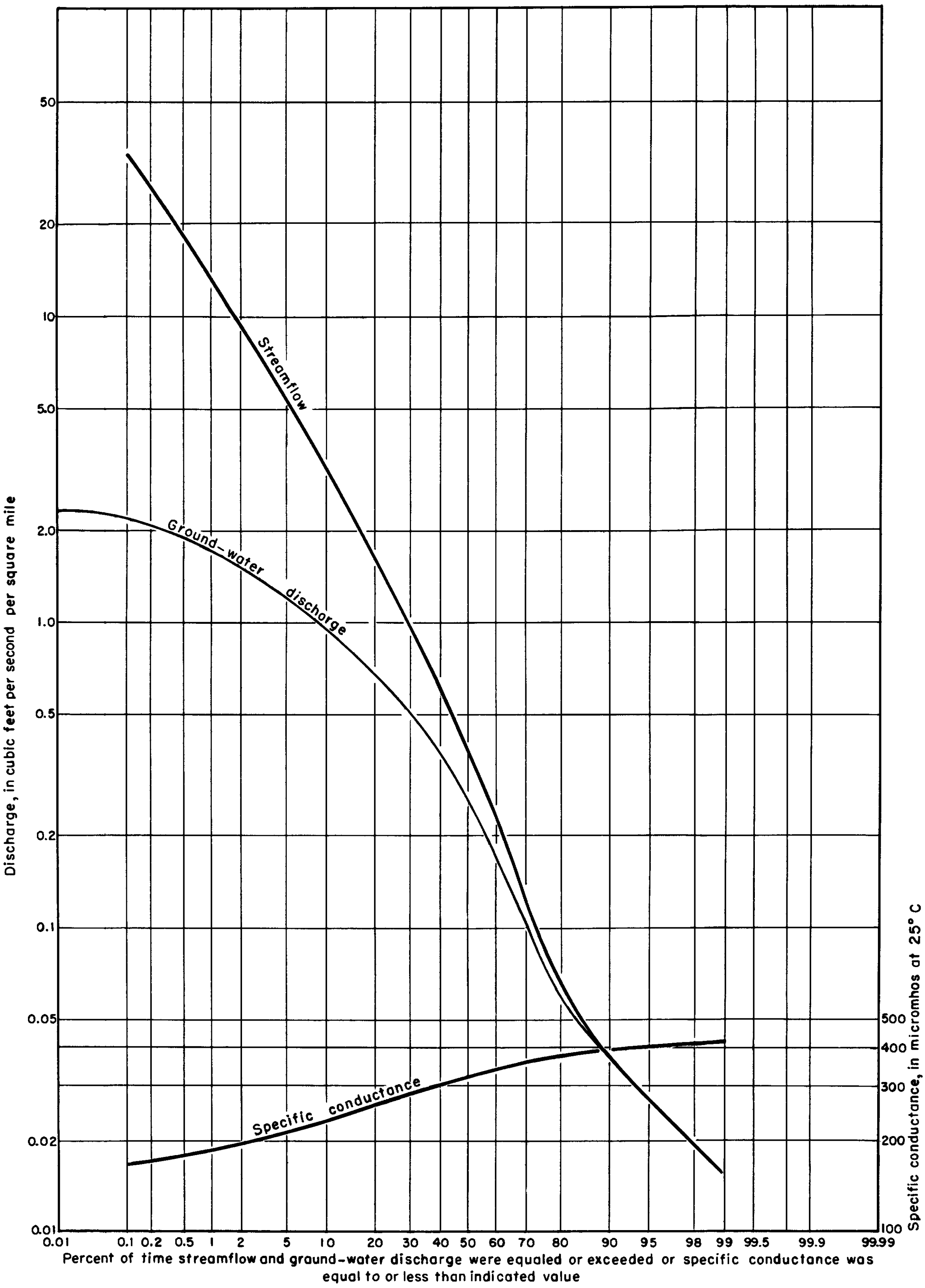


Figure 17.--Duration curves of streamflow, ground-water discharge, and specific conductance, Little Tonawanda Creek at Linden, adjusted to 1931-60 base period.

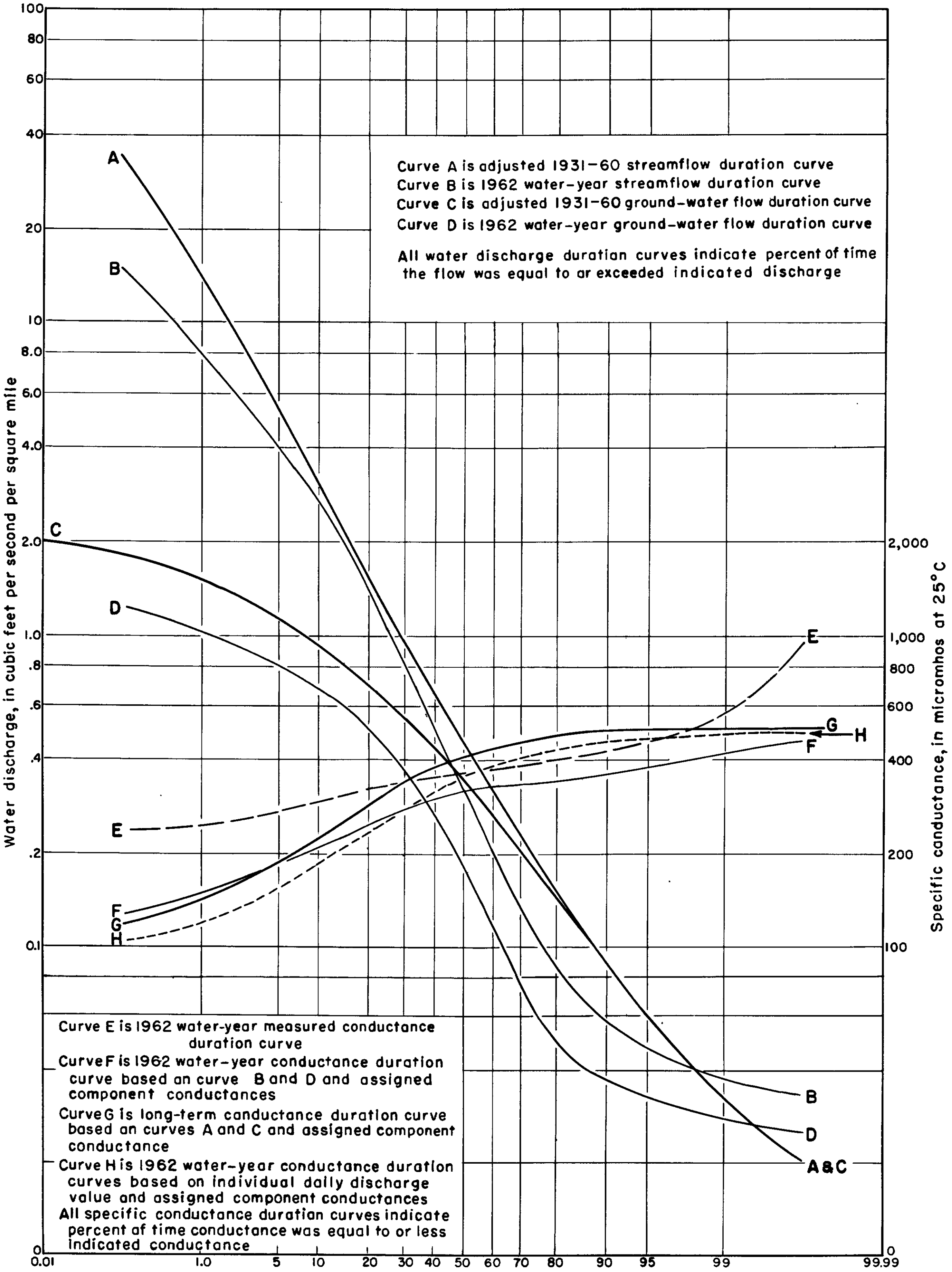


Figure 18.--Duration curves of streamflow, ground-water discharge, and specific conductance, Buffalo Creek at Gardenville.

ground-water discharge was estimated by the methods described in the ground-water report by LaSala (1968). The curves are discussed in those reports.

Note that the scale on the left side of each curve is expressed as flow or discharge in cubic feet per second per square mile of drainage area, and that the scale on the right side is specific conductance in micromhos. The specific conductance curves were prepared by computing the specific conductance of streamflow for several duration points, using the computed streamflow quality equation given on page 38 and the specific conductance values for overland flow and ground water given on page 40. Additional methods of computation were used to determine the other specific conductance duration curves in figure 18, as indicated. The fact that the duration lines in figure 18 of computed and measured conductance for like periods do not coincide with each other is probably an indication both of inaccurate or nonrepresentative data used in the computations (at least partly because of the large size of the area), and of the fact that equal percent-duration for ground water and streamflow are not necessarily concurrent.

EFFECTS OF CHEMICAL CONSTITUENTS AND PROPERTIES UPON USE OF WATER

The chemical quality of water has a major effect upon the number of purposes for which the water may be used without treatment and the types of treatment required for some types of water use. Some uses require water with very low dissolved-solids content, whereas other uses, such as industrial cooling, can be met with water of high dissolved-solids content.

Much has been written on the subject of water-quality characteristics, tolerances, and treatment, including publications by the U.S. Public Health Service (1962), Betz Laboratories (1962), the California State Water Quality Control Board (McKee and Wolf, 1963), Hem (1959), Nordell (1961), and Powell (1954). Therefore, the only additional information presented here is in table 13 showing the source or cause and significance of dissolved mineral constituents and properties, along with representative ranges in chemical quality found in the Erie-Niagara basin.

The sanitary quality of a water also is important with respect to its suitability for an intended use. However, this subject is included in a report being prepared by the State Department of Health and therefore is not discussed in this report. The New York State Department of Health (1951, 1953, 1957, 1962) has published several reports within the past 15 years describing stream pollution in parts of the Erie-Niagara basin.

Table 13.--Source or cause and significance of dissolved mineral constituents and properties of water as related to the Erie-Niagara basin

Constituent or property	Source or cause	Significance	Concentration (ppm) values commonly found in streams in the Erie-Niagara basin (except at times of very low or very high flow): Entire area except lower Tonawanda Creek basin	Concentration (ppm) values commonly found in streams in the Erie-Niagara basin (except at times of very low or very high flow): Lower Tonawanda Creek basin	Federal drinking water standards 1/ (parts per million)
Alkyl benzene sulfonate (ABS)	Synthetic detergents in domestic, and industrial wastes.	Causes tastes and odors, and causes foam on streams and in treatment plants. Treatment somewhat difficult and generally incomplete.	0.0-.4	0.0-.2	0.5
Bicarbonate (HCO_3) Carbonate (CO_3)	Action of carbon dioxide in water on carbonate cementing material and rocks, such as limestone and dolomite.	Produces alkalinity. On heating in the presence of calcium and magnesium can form scales in pipes and release corrosive carbon-dioxide gas. Aid in coagulation for the removal of suspended matter from water.	HCO_3 91-180 CO_3 0	150-230 0	--
Calcium (Ca), Magnesium (Mg)	Dissolved from practically all soils and rocks, but especially from limestone, dolomite, and gypsum.	Causes most of the hardness and scale-forming properties of water; detergent consuming (see hardness). Water low in calcium and magnesium desired in electroplating, tanning, dyeing, and in textile manufacturing. Small amounts desirable to prevent corrosion.	Ca 32-58 Mg 6-12	58-160 11-22	--
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and industrial wastes.	Some people can detect salty taste in concentrations exceeding 100 ppm. Large quantities increases the corrosiveness of water. Present available treatment methods not generally economical for most uses.	6-22	19-71	250
Color	Decaying vegetation; peat, leaves, roots and other organic substances, industrial wastes and sewage and certain minerals.	Water for domestic and some industrial uses should be free from perceptible color. Color in water is objectionable in food and beverage processing and many manufacturing processes.	3-9	6-26	--
Dissolved solids (residue on evaporation)	Chiefly mineral constituents dissolved from rocks and soils. Includes some water of crystallization.	Waters containing more than 1,000 ppm of dissolved solids are unsuitable for many purposes.	140-240	260-720	500
Fluoride (F)	Dissolved in small to minute quantities from most rocks and soils. Added to many waters by fluoridation of public supplies.	Fluoride concentrations between 0.8 and 1.5 ppm accepted as range for beneficial effect on the structure and resistance to decay of children's teeth in study area as based on the average annual daily maximum temperature of 56.3°F at Buffalo (Johnson, 1960, p. 11). Fluoride in excess of 6.0 ppm causes pronounced mottling and disfiguration of teeth.	0.0-.2	0.2-.4	--
Hardness as $CaCO_3$	In most waters nearly all hardness due to calcium and magnesium.	Consumes soap and synthetic detergents. Although less of a factor with synthetic detergents than with soap, it is still economical to soften hard waters (Aultman, 1958).	100-190	190-490	--
Hydrogen ion, concentration (pH)	Hydrogen ion concentration.	A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increased alkalinity; values lower than 7.0 indicate increased acidity. Corrosiveness of water generally increased with decreasing pH, but excessively alkaline waters may also attack metals.	7.3-8.1	7.2-8.0	--

1/ U.S. Public Health Service (1962).

Table 13.--Source or cause and significance of dissolved mineral constituents and properties of water as related to the Erie-Niagara basin (Continued)

Constituent or property	Source or cause	Significance	Concentration (ppm) values commonly found in streams in the Erie-Niagara basin (except at times of very low or very high flow): Entire area except lower Tonawanda Creek basin	Concentration (ppm) values commonly found in streams in the Erie-Niagara basin (except at times of very low or very high flow): Lower Tonawanda Creek basin	Federal drinking water standards 1/ (parts per million)
Iron (Fe)	Dissolved from practically all rocks and soils. Found in some industrial wastes. Can be corroded from iron pipes, pumps and other equipment.	More than 0.1 ppm often precipitates on exposure to air, causing turbidity, staining and tastes and colors which are objectionable in food, beverage, textile processes and ice manufacture as well as the cause of problems in domestic use such as staining plumbing fixtures and laundry.	0.03-.19	0.05-.19	0.3
Manganese (Mn)	Dissolved from some rocks, soils, and lake bottom sediments. Sources associated with those of iron.	Same objectionable features as iron. Causes dark brown or black stains. Manganese removal associated with that of iron but more difficult and generally less complete.	0.00-.03	0.01-.17	.05
Nitrate (NO_3)	Decaying organic matter, sewage, fertilizers and nitrates in soils.	Small amounts of nitrate help reduce cracking of high-pressure boiler steel. It encourages growth of algae and other organisms which produce undesirable taste and odors. Concentrations in excess of 45 ppm limit are suspected as cause of methemoglobinemia in infants.	0.4-4.6	0.6-3.5	45
Silica (SiO_2)	Dissolved from practically all rocks and soils.	Together with calcium and magnesium, silica forms a low-heat conducting hard glassy scale in boilers and turbines. Silica inhibits deterioration of zeolite-type water softeners and corrosion of iron pipes by soft water.	1-6	1-7	--
Sodium (Na), Potassium (K)	Dissolved from practically all rocks and soils. Found in industrial wastes and sewage.	More than 50 ppm sodium and potassium in the presence of suspended matter causes foam in boilers which accelerates scale formation and corrosion. More than 65 ppm of sodium can cause problems in ice manufacture. (Durfor and Becker, 1964a, p. 17)	Na 3-12 K 1-3	9-30 2-4	--
Specific conductance	Mineral content of the water.	Guide to mineral content. It is a measure of the capacity of the water to conduct a current of electricity, and varies with the concentration and degree of ionization of the different minerals in solution.	230-420	420-1,000	--
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, sulfides, and other sulfur compounds. May be derived from industrial wastes, both liquid and atmospheric.	Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate in combination with other ions gives bitter taste to water. Some calcium sulfate is considered beneficial in brewing processes.	22-55	40-350	250
Turbidity	Suspended and colloidal matter. Sources can be soil erosion, industrial wastes, micro-organisms.	Turbid water aesthetically objectionable. Also, objectionable in many industrial processes; generally removed by sedimentation, clarification or filtration.	0.0-.7	0.2-.7	--

1/ U.S. Public Health Service (1962).

CONCLUSIONS

The natural chemical quality of water in streams in most of the Erie-Niagara basin is good, and except for water in the lower Tonawanda Creek basin, little or no chemical quality treatment is needed for public water supply. Because of pollution, however, the sanitary quality and chemical quality of some streams is poor, especially in the immediate Buffalo area and in the downstream parts of several of the larger streams.

In much of the region, the dissolved-solids content of streams is between 140 and 240 ppm most of the time. The water is generally "hard," but the hardness of water in most streams is usually less than 200 ppm (expressed as $CaCO_3$). The iron content is less than 0.2 ppm throughout the area most of the time, and the hydrogen-ion concentration (pH) is usually between 7.0 and 8.0. Chloride concentrations are generally less than 20 ppm (except in the northern part of the area), and concentrations of nitrate seldom exceed 5 ppm in most of the region.

Although there are many local variations in chemical quality, especially at times of low streamflow, the only large part of the region with problems related to natural water quality is the lower Tonawanda Creek basin, from Batavia to the Niagara River, including Ellicott Creek. Most of this problem area is underlain by the Camillus Shale, from which calcium, sulfate, and other constituents are readily dissolved. Water in streams of that area often contains between 300 and 700 ppm (or more) of dissolved solids, 100 to more than 300 ppm of sulfate, 20 to 70 ppm (or more) of chloride, and usually has a hardness of between 200 and 500 ppm.

Ground water is the principal source of the dissolved minerals in the streams, especially during periods of low and moderate streamflow. The chemical quality of this ground water is a result of the presence of relatively soluble minerals in the various types of bedrock -- shale, sandstone, limestone, and dolomite -- which underlie the region beneath glacial deposits of clay, sand, and gravel. However, at times of heavy precipitation or snowmelt, the dissolved-mineral content in streams is more dilute, inasmuch as streamflow consists predominantly of water from overland flow, which in turn is largely the water precipitated on the area as rain or snow.

Regionwide the average chemical content of precipitation, based on records for the greater part of 1 year, included about 5 ppm of calcium, 10 ppm of sulfate, 0.1 ppm of chloride, and 35 ppm of dissolved solids. However, substantially higher concentrations sometimes occur, principally in the northern part of the area; and the limited sampling pointed to snow having a higher mineral content than rain. The source of much of this dissolved mineral matter found in precipitation is believed to be the burned or partly burned residues released to the air by industries in the Buffalo area, and to a lesser extent by industries to the west of the region, near other parts of the Great Lakes.

The types of data contained in this report make it possible to compute daily values (within an accuracy of about 5 to 20 percent) of the chemical characteristics for a given flow of a stream, if the stream represents a homogeneous hydrologic environment with an area of less than 50 square miles, if a continuous record of streamflow is maintained and if the effects of pollution are minimal. The chief inadequacies of data for this type of computation for small streams concern high flows of the streams.

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APPENDIX A
NUMBERING SYSTEM FOR SAMPLING SITES

Sampling sites referred to in this report are numbered under several systems according to the types of samples. All stream-sampling sites are numbered according to the system adapted by the New York State Health Department from a system introduced by the New York State Conservation Department. In this system, tributaries to the Great Lakes are numbered in a clockwise direction, and their tributaries are numbered consecutively, progressing upstream from the mouth. For example, Cattaraugus Creek, the 23d tributary to Lake Erie is numbered E23, whereas Elton Creek, the 48th upstream tributary to Cattaraugus Creek, is numbered E23-48. Specific sites are designated by adding to this "water index number," in parentheses, the "mileage index number," which is the distance in miles upstream from the mouth of the particular stream. Hence, the site on Elton Creek at The Forks, 0.6 mile upstream from the mouth of Elton Creek is numbered E23-48(0.6). The Niagara River is the 158th tributary of Lake Ontario, hence it is numbered 0158. Index maps showing "water index numbers" for most streams listed in the tables of this report are included in the reports of the New York State Department of Health (1951, 1953, and 1957).

Sampling sites on the New York State Barge Canal system are numbered under the system used by the Waterway Operation and Maintenance Subdivision of the New York State Department of Public Works, whereby each bridge crossing the Canal is numbered and the distance in miles along the Canal west of the bridge is put in parentheses after the bridge number. Hence, the site Barge (Erie) Canal at Lock 35, at Lockport, is numbered E230(0.8) and is 0.8 mile west of bridge 230.

In addition to the State system, many of the stream-sampling sites referred to in this report are also numbered in the U.S. Geological Survey national stream-station-numbering system. In this system numbers are assigned in a downstream order, but intervals are left in the numbers to allow for later additions. The number for Elton Creek at the Forks is 2134.2. Table 24 was prepared as a cross-reference of the State sampling-point mileage index number and the latitude and longitude of each of the sampling sites; also included in this table are the U.S. Geological Survey station numbers, where used.

The numbering of snow and overland-flow sampling sites used in this report is based on latitude and longitude. Each number consists of three parts: first, the last digit of the degree of latitude, and the two digits for the minutes of latitude of the southeast corner of the 1-minute quadrangle in which the sampling site occurs; second, the similar digits of longitude; and third, the letter P for the snow sites or letter A, B, C, or D for the overland-flow sites, the choice depending on the order of previous miscellaneous observations within the quadrangle.

APPENDIX B
BASIC DATA TABLES

Table 14.--Chemical analyses of precipitation

Location: At Arcade Latitude 42°32' Longitude 78°25'

Point of collection: At 96 Liberty St.

Date of collection	Measured amount (inches of water)	Calcium (Ca) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Specific conductance (micromhos at 25°C)	pH
3- 8-63	0.17	--	5.5	0.0	37	6.4
3-17-63	.53	--	13	.0	66	6.5
3-26-63	.21	--	11	.1	61	6.7
4- 4-63	.75	--	3.5	.0	28	6.6
4-17-63	.27	--	13	.1	65	6.6
4-19-63	1.30	--	6.1	.0	35	6.3
4-23-63	.50	--	6.9	.0	33	6.4
7-20-63	1.28	4.2	17	.0	26	6.4
8- 7-63	.91	3.1	5.0	.0	15	6.2
8-13-63	.51	5.6	7.1	.0	32	6.2
8-14-63	--	3.2	4.5	.0	15	6.4
Maximum observed		5.6	17	0.1	66	6.7
Minimum observed		3.1	3.5	.0	15	6.2
Median		3.7	6.9	.0	33	6.4

Table 14.--Chemical analyses of precipitation (Continued)

Location: At Gowanda Latitude 42°29' Longitude 78°56'

Point of collection: At Gowanda State Hospital

Date of collection	Measured amount (inches of water)	Calcium (Ca) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Specific conductance (micromhos at 25°C)	pH
3- 2-63	0.31	--	16	5.9	129	7.1
3- 6-63	.23	--	41	--	170	6.0
3-13-63	.41	--	17	.0	109	6.1
3-20-63	.35	--	18	.6	65	6.0
4- 4-63	.65	--	11	.0	56	5.9
4-23-63	.42	--	99	.0	283	6.0
6-12-63	--	--	32	.0	114	6.3
6-29-63	.50	12	24	.0	109	6.3
7-20-63	1.70	6.5	17	.0	72	6.3
7-30-63	.56	4.7	20	.0	30	6.2
8- 8-63	.98	7.7	20	.0	61	6.0
8-13-63	.55	5.6	17	.0	50	5.9
8-14-63	1.48	2.6	8.0	.0	16	6.3
9- 4-63	.45	6.4	14	.0	40	6.2
9-13-63	.50	6.5	13	.0	51	6.1
Maximum observed		12	99	5.9	283	7.1
Minimum observed		2.6	8.0	.0	16	5.9
Median		6.4	17	.0	65	6.1

Table 14.--Chemical analyses of precipitation (Continued)

Location: At Colden Latitude 42°40' Longitude 78°41'

Point of collection: On route 240, 1 mile north of Colden

Date of collection	Measured amount (inches of water)	Calcium (Ca) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Specific conductance (micromhos at 25°C)	pH
3-12-63	--	--	13	0.1	52	5.9
3-13-63	--	--	14	.1	60	6.2
3-30-63	--	--	16	.0	64	6.1
4- 4-63	--	--	7.9	.0	41	6.2
4-17-63	--	--	4.3	.0	29	6.4
4-19-63	--	--	8.1	.0	45	6.5
4-20-63	--	--	3.5	.0	22	6.4
4-23-63	--	--	7.5	.0	32	6.2
4-30-63	--	--	5.7	.0	32	6.4
5- 9-63	--	--	16	.0	68	6.6
5-20-63	--	--	4.9	.0	32	6.6
5-29-63	--	--	4.3	.0	24	6.4
6-10-63	--	--	4.3	.0	34	6.2
7- 2-63	--	26	39	.0	202	7.0
7-19-63	--	4.2	10	.0	30	6.0
7-29-63	--	3.2	8.7	.0	20	6.0
8- 7-63	--	4.0	17	.0	44	6.4
8-13-63	--	3.8	18	.0	30	6.4
8-14-63	--	2.8	5.0	1.1	24	6.8
9-20-63	--	4.1	9.5	.0	29	6.3
Maximum observed		26	39	1.1	202	7.0
Minimum observed		2.8	3.5	.0	20	5.9
Median		4.1	9.1	.0	32	6.2

Table 14.--Chemical analyses of precipitation (Continued)

Location: At Emery Park, South Wales — Latitude 42°43' — Longitude 78°36'

Point of collection: At 2084 Emery Rd.

Date of collection	Measured amount (inches of water)	Calcium (Ca) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Specific conductance (micromhos at 25°C)	pH
3- 2-63	0.25	--	7.1	0.0	36	5.4
4- 4-63	.91	--	13	.0	56	6.5
4-24-63	.28	--	24	1.0	72	6.5
5- 1-63	.30	--	14	.0	54	6.6
5- 9-63	.62	--	15	.0	64	6.6
5-10-63	.28	--	15	.0	63	6.6
5-20-63	.40	--	15	.0	59	6.7
6-10-63	1.75	--	7.1	.0	37	6.5
7-15-63	.52	8.9	19	.0	75	6.6
7-19-63	1.20	4.4	14	.0	44	6.4
7-29-63	.70	4.0	12	.0	30	6.5
8- 8-63	1.55	8.1	11	.0	29	6.5
8-13-63	.65	3.0	10	.0	38	6.5
8-14-63	1.60	1.6	7.1	.0	16	6.7
9-13-63	.74	3.2	7.1	.0	32	6.4
9-20-63	.60	3.9	8.9	.0	39	6.7
Maximum observed		8.9	24	1.0	75	6.7
Minimum observed		1.6	7.1	.0	16	5.4
Median		4.0	12	.0	42	6.5

Table 14.--Chemical analyses of precipitation (Continued)

Location: At Linden Latitude 42°53' Longitude 78°10'

Point of collection: On Linden Rd. at Linden

Date of collection	Measured amount (inches of water) [a/]	Calcium (Ca) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Specific conductance (micromhos at 25°C)	pH
3-13-63	--	--	15	0.1	70	6.5
3-26-63	0.35	--	54	.4	214	6.7
4- 2-63	--	--	18	.1	77	6.6
4- 4-63	1.10	--	10	.1	89	6.9
4-18-63	.45	--	40	2.8	200	7.0
4-19-63	.50	--	9.5	.2	87	7.0
4-20-63	.90	--	10	.3	75	7.0
5- 9-63	1.10	--	4.7	.7	97	6.4
5-29-63	.50	--	14	.9	112	6.8
7-19-63	--	3.2	8.9	.0	39	6.6
7-29-63	--	4.4	7.1	.0	57	6.9
8- 6-63	.35	4.8	10	.0	63	6.8
8-13-63	--	3.3	8.0	.0	42	6.6
8-29-63	.50	6.0	13	.0	65	6.8
9-20-63	--	7.2	9.1	.0	59	6.7
Maximum observed		7.2	54	2.8	214	7.0
Minimum observed		3.2	4.7	.0	39	6.4
Median		4.8	10	.1	75	6.8

a/ Amount reported for collection period does not necessarily correspond with data published by the Weather Bureau.

Table 14.--Chemical analyses of precipitation (Continued)

Location: At Cheektowaga Latitude 42°56' Longitude 78°25'

Point of collection: Buffalo International Airport

Date of collection	Measured a/ amount (inches of water)	Calcium (Ca) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Specific conductance (micromhos at 25°C)	pH
4-17-63	0.24	--	30	1.2	138	6.6
4-19-63 b/	.31	--	11	.3	52	6.5
4-19-63 c/	.60	--	9.5	.1	39	6.0
5- 1-63	.40	--	12	.2	58	6.8
5- 8-63	.40	--	11	.9	56	6.7
5-20-63	--	--	10	--	50	6.8
7- 2-63	1.00	9.6	20	.0	88	6.5
7-19-63	.83	6.4	14	.0	66	6.3
7-29-63	--	3.7	16	.0	40	5.9
8-13-63	--	3.0	12	.0	29	5.8
8-30-63	--	5.5	13	.0	51	5.9
9-12-63	--	10	13	.0	67	6.5
Maximum observed		10	30	1.2	138	6.8
Minimum observed		3.0	9.5	.0	29	5.8
Median		6.0	12	.0	54	6.5

a/ Amount reported for collection period does not necessarily correspond with data published by the Weather Bureau.
b/ Collected at 1145 hrs.
c/ Collected at 2000 hrs.

Table 14.--Chemical analyses of precipitation (Continued)

Location: At Batavia Latitude 43°00' Longitude 78°11'

Point of collection: At County Highway Dept. on Mill St.

Date of collection	Measured amount (inches of water)	Calcium (Ca) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Specific conductance (micromhos at 25°C)	pH
3-13-63	0.52	--	28	4.9	130	6.8
3-20-63	.33	--	26	1.5	116	6.6
4- 4-63	.73	--	4.9	1.1	38	6.9
4-19-63	.84	--	16	1.0	63	6.4
4-20-63	.44	--	8.1	.0	40	6.7
4-23-63	.31	--	25	.2	89	6.3
5- 1-63	--	--	25	6.7	110	6.3
5- 9-63	.76	--	15	1.1	68	6.6
5-10-63	.70	--	10	.0	40	6.5
5-20-63	.25	--	17	1.8	63	6.4
7- 2-63	1.28	6.9	10	.0	71	6.0
7-19-63	1.48	5.8	30	.0	42	5.9
7-29-63	.57	6.9	14	.0	61	6.0
8- 1-63	.91	5.6	12	.0	45	6.0
8-13-63	1.35	5.4	12	.0	41	6.1
9-13-63	--	8.5	17	.0	68	6.0
Maximum observed		8.5	30	6.7	130	6.9
Minimum observed		5.4	4.9	.0	38	5.9
Median		5.7	16	.1	63	6.4

Table 15.--Chemical analyses of snow

Sampling site number.--See appendix A.

Sampling site number	Location	Point of collection	Date of collection	Calcium (Ca) (ppm)	Magnesium (Mg) (ppm)	Sodium (Na) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
221-841-P	At Plato	On Plato Rd., 500 ft south of bridge over East Otto 1.0 mile west of Plato.	Feb. 17, 1964	--	--	--	--	--	--	--	36	--
222-847-P	Near Otto	At intersection of East Otto, Thompson and Scotts Corners Rds., 2 miles northeast of Otto.	Feb. 17, 1964	6.5	--	--	8.6	4.1	--	--	61	--
224-836-P	At West Valley	On Rt. 219, 200 ft north of Fenton Hill Rd.	Feb. 17, 1964	--	--	--	--	--	--	--	70	--
225-856-P	Near Gowanda	On Rt. 62, at intersection with Van Etten Rd., 2 miles south of Gowanda.	Feb. 17, 1964	--	--	--	--	--	--	--	40	--
226-841-P	Near Springville	At intersection of Rt. 219 and Connoisarauley Rd.	Feb. 17, 1964	2.4	--	--	3.8	1.4	--	--	25	4.8
227-853-P	Near Gowanda	On Gowanda-Zoar Rd., 2 miles east of Gowanda.	Feb. 17, 1964	1.7	--	--	2.4	2.1	--	34	70	3.50
229-822-P	At Sandusky	Between Rt. 98 and Clear Creek at southeast side of Sandusky.	Feb. 17, 1964	--	--	--	--	--	--	--	87	--
229-828-P	At Delevan	On Rt. 16 at north side of Delevan.	Feb. 17, 1964	--	--	--	--	--	--	--	51	--
229-850-P	At Collins Center	On Rt. 75 in Catholic Church parking lot.	Feb. 17, 1964	--	--	--	--	--	--	--	78	--
229-855-P	At Collins	At intersection of Rt. 62 and 39.	Feb. 17, 1964	1.0	--	--	4.2	3.8	--	--	60	--
230-835-P	Near Springville	At intersection of Rt. 39 and Van Slyke Rd., halfway between Springville and Sardinia.	Feb. 17, 1964	4.6	--	--	5.8	3.9	--	--	57	--
230-841-P	At Springville	At intersection of Rts. 219 and 39 west of Springville.	Feb. 17, 1964	--	--	--	--	--	--	--	41	--
232-825-P	At Arcade	At intersection of Rt. 98 and North St. at east side of Arcade.	Feb. 17, 1964	--	--	--	--	--	--	--	69	--
232-901-P	Near Iroquois	At intersection of Mile Level and Brant-Reservation Rds., and 500 ft west of Clear Creek.	Feb. 17, 1964	--	--	--	--	--	--	--	32	--
234-828-P	At Chaffee	On Allen Rd. at west side of Chaffee.	Feb. 17, 1964	2.0	--	--	3.8	1.2	--	--	29	4.30
234-834-P	Near Chaffee	On Allen Rd., halfway between Chaffee and East Concord.	Feb. 17, 1964	1.7	--	--	3.4	32	--	--	125	4.20
235-852-P	At Langford	At intersection of Rt. 249 and Jennings Rd., 0.5 mile west of Langford.	Feb. 18, 1964	.9	--	--	2.6	.7	--	--	13	3.90
235-905-P	At Farnham	On Lotus Point Rd., 0.2 mile west of Farnham.	Feb. 17, 1964	--	--	--	--	--	--	--	33	--
236-856-P	At North Collins	On Rt. 62, at Franklin Gulf Brook.	Feb. 18, 1964	--	--	--	--	--	--	--	33	--
237-820-P	At East Java	On Chaffee Rd., 1,500 ft east of Cattaraugus Creek.	Feb. 17, 1964	17	--	--	23	9.5	--	--	160	--
239-833-P	At Holland	On Rt. 16, 0.5 mile north of Holland and 200 ft south of "twin brooks" crossing.	Feb. 18, 1964	--	--	--	--	--	--	--	28	--
239-902-P	At Evans Center	At intersection of Bennett and Farm Rds., 0.2 mile west of Evans Center.	Feb. 17, 1964	1.4	--	--	1.8	0	--	--	18	4.40
241-826-P	At Strykersville	On Rt. 78, at brook in Strykersville.	Feb. 18, 1964	--	--	--	--	--	--	--	37	--
241-852-P	At Eden Valley	On Webster Rd., 0.2 mile west of Rt. 62 and 0.5 mile north of Eden Valley.	Feb. 17, 1964	2.2	--	--	5.0	4.1	--	--	34	4.7
242-820-P	At North Java Station	At intersection of Rt. 98 and Almeter Rd.	Feb. 18, 1964	--	--	--	--	--	--	--	24	--

Table 15.--Chemical analyses of snow (Continued)

Sampling site number	Location	Point of collection	Date of collection	Calcium (Ca) (ppm)	Magnesium (Mg) (ppm)	Sodium (Na) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
244-835-P	At Blakely	At intersection of Blakely Corners Rd., and Rt. 16 at west side of Blakely.	Feb. 17, 1964	--	--	--	--	--	--	--	439	3.40
244-849-P	At Hamburg	At Erie County fairgrounds on Rt. 62.	Feb. 17, 1964	--	--	--	--	--	--	--	33	--
246-818-P	Near Varysburg	On Schlenker Rd., 1.2 miles northeast of Varysburg.	Feb. 17, 1964	2.0	--	--	12	2.1	--	--	62	4.15
246-821-P	do.	At intersection of Rt. 20A and French Rd., 2 miles west of Varysburg.	Feb. 17, 1964	--	--	--	--	--	--	--	229	3.80
246-829-P	Near Wales Center	On Rt. 20A, near Stony Bottom Creek, 2.2 miles east of Wales Center.	Feb. 17, 1964	9.6	--	--	222	44	--	327	890	3.00
246-835-P	At East Aurora	On Rt. 20A at east side of East Aurora.	Feb. 17, 1964	--	--	--	--	--	--	--	52	--
246-842-P	Near Orchard Park	On Rt. 20A, 1.6 miles east of Orchard Park.	Feb. 17, 1964	2.0	--	--	7.8	3.1	--	--	24	--
247-849-P	At Blasdell	On Lake Ave. east of Rt. 62.	Feb. 18, 1964	2.4	--	--	2.6	14	--	--	61	--
248-833-P	At Porterville	At intersection of Rts. 358 and 422.	Feb. 17, 1964	14	5.1	1.3	21	62	56	--	298	3.75
			Jan. 14, 1965	2.3	--	--	3.6	4.7	--	--	40	6.2
			Feb. 2	1.4	--	--	2.8	1.7	--	--	24	5.4
248-839-P	Near East Aurora	On Rt. 16, at former Proner Airport, 3 miles northwest of East Aurora.	Feb. 17, 1964	8.8	6.8	6.9	126	30	50	--	540	3.30
250-817-P	At Attica	On Rt. 98, at Attica and Arcade RR crossing south of Attica.	Feb. 17, 1964	3.3	--	--	4.6	4.8	--	--	46	--
251-814-P	Near Attica	On road to Vernal Corners, 2.5 miles east of Attica.	Feb. 17, 1964	8.6	--	--	18	8.4	--	--	110	--
251-829-P	Near Alden	On Rt. 239, 2 miles south of Alden.	Feb. 17, 1964	--	--	--	--	--	--	--	292	3.85
251-845-P	At Gardenville	On Rt. 354, 0.2 mile east of Rt. 277.	Feb. 18, 1964	--	--	--	--	--	--	--	54	--
			Jan. 14, 1965	6.4	--	--	7.8	31	--	--	153	6.8
			Feb. 2	4.0	--	--	5.2	7.3	--	--	52	5.6
252-834-P	At Town Line	On Town Line Rd. at Cayuga Creek, south of Town Line.	Feb. 17, 1964	2.0	--	--	6.6	1.8	--	--	54	3.80
			Jan. 14, 1965	3.2	--	--	2.8	2.0	--	--	26	6.6
			Feb. 2	2.0	--	--	1.4	1.2	--	--	29	4.6
254-823-P	At Darien Center	At intersection of Rts. 77 and 20.	Feb. 17, 1964	6.4	11	1.6	217	22	60	--	632	3.30
			Jan. 14, 1965	2.3	--	--	0	4.4	--	--	21	5.1
			Feb. 2	1.4	--	--	1.4	4.9	--	--	33	4.8
254-845-P	Near Williamsville	On Union Rd., 0.8 mile south of Rt. 33.	Feb. 18, 1964	9.6	--	--	36	13	--	--	143	--
256-814-P	Near Alexander	At intersection of Rt. 98 and Cookson Rd., 2.5 miles northeast of Alexander.	Feb. 17, 1964	--	--	--	--	--	--	--	57	4.20
256-835-P	Near Clarence	At intersection of Ransom and Schlimmer Rds. southeast of Ellicott Creek and 2 miles south of Clarence.	Feb. 17, 1964	3.3	--	--	62	0	--	--	401	3.20
256-840-P	At Bowmansville	On Martha Dr. off Rt. 33 in front of Bowmansville School.	Feb. 18, 1964	--	--	--	--	--	--	--	124	4.00
257-823-P	At Corfu	On Rt. 33, at Murder Creek, eastside of Corfu.	Feb. 17, 1964	--	--	--	--	--	--	--	66	4.00
258-847-P	Near Williamsville	At intersection of Rts. 263 and 324.	Feb. 18, 1964	--	--	--	--	--	--	--	120	4.00
259-814-P	Near Batavia	On Rt. 33, 2 miles west of Batavia.	Feb. 17, 1964	2.2	--	--	3.0	5.6	--	--	31	--
			Jan. 14, 1965	1.0	--	--	.2	.3	--	--	11	5.6
			Feb. 2	2.9	--	--	3.4	13	--	--	70	5.0

Table 15.--Chemical analyses of snow (Continued)

Sampling site number	Location	Point of collection	Date of collection	Calcium (Ca) (ppm)	Magnesium (Mg) (ppm)	Sodium (Na) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
259-840-P	Near Clarence	At Brookfield Golf and Country Club on Grenier Rd.	Feb. 18, 1964	--	--	--	--	--	--	--	144	4.50
300-808-P	Near Batavia	At Batavia Golf Club on Rt. 33A.	Feb. 18, 1964	9.4	--	--	67	31	--	132	270	3.90
301-829-P	At Akron	At Evergreen Cemetery on Bloomingdale Rd.	Feb. 17, 1964	11	--	--	25	1.2	--	--	88	4.7
301-835-P	At Hunts Corners	At intersection of Rt. 268 and Hunts Corners - Akron Rd.	Feb. 17, 1964	4.8	9.2	1.6	174	28	50	--	496	3.60
			Jan. 14, 1965	1.4	--	--	.0	1.6	--	--	14	5.0
			Feb. 2	3.7	--	--	6.6	3.5	--	--	43	4.8
301-845-P	At Getzville	On Dodge Rd., east of Rt. 270.	Feb. 17, 1964	--	--	--	--	--	--	--	354	3.50
304-849-P	At Beach Ridge	At intersection of Town Line and Hill Rds.	Feb. 17, 1964	6.4	--	--	58	20	--	130	235	3.90
305-827-P	At Tonawanda Indian Reservation	At intersection of Hopkins and Syke Rds.	Feb. 17, 1964	--	--	--	--	--	--	--	243	3.50
305-838-P	At Rapids	At intersection of Rt. 268 and Goodrich Rd.	Feb. 17, 1964	--	--	--	--	--	--	--	50	4.15
307-834-P	At Dysinger	At intersection of Rt. 93 and Bunker Hill Rd.	Feb. 17, 1964	--	--	--	--	--	--	--	44	4.50
307-841-P	Near Lockport	At intersection of Rt. 78 and Robinson Rd.	Feb. 17, 1964	18	--	--	167	22	--	299	788	3.20
307-847-P	At Mapleton	At intersection of Mapleton and Aiken Rd.	Feb. 17, 1964	3.2	--	--	7.0	2.0	--	--	39	--

Table 16.--Chemical analyses of overland flow

Sampling site number.--See appendix A.

Sampling site number	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Calcium, magnesium hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
223-846-A	Near East Otto	On East Otto Rd., 0.3 mile southwest of Swamp Rd.	Mar. 5, 1964	0845	10	0.7	17	--	46	--
224-841-A	At Ashford Hollow	On Rt. 219, opposite old cemetery.	Mar. 5, 1964	0715	12	2.1	21	--	45	--
224-843-A	Near Ashford Hollow	On Bowen Rd., 0.7 mile south of Whitford Hollow, on east side of Mount Tug.	Mar. 5, 1964	0757	10	.8	16	--	38	--
225-851-A	Near Otto	On Forty Rd., 0.6 mile northwest of Dake Hill Rd.	Mar. 5, 1964	0930	21	--	--	64	86	--
226-841-A	Near Ashford Hollow	On Connoisarauley Rd., 300 ft west of Rt.219.	Mar. 5, 1964	0730	--	--	--	--	180	--
227-820-A	Near Freedom	On Osmum Rd., 0.4 mile southeast of Crystal Lake.	Mar. 5, 1964	0245	8.0	.7	14	--	43	--
227-824-A	Near Elton	On Cheeseman Hill Rd., 0.2 mile west of Maple Grove Rd.	Mar. 5, 1964	0330	16	.8	18	--	54	--
228-836-A	Near Riceville	On Beech Tree Rd., 0.2 mile south of Folts Rd.	Mar. 5, 1964	0525	7.8	.5	8	--	25	--
232-824-A	At Arcade	On Rt. 98 at northeast village line.	Mar. 26, 1963	--	17	3.7	--	--	117	6.8
233-857-A	Near Lawtons	On Mile Block Rd., 0.8 mile north of Newtown and 1.4 miles northwest of Lawtons.	Mar. 5, 1964	--	14	1.5	19	--	59	--
234-830-B	Near Sardinia	On Chaffee-Johnston Corners Rd., 0.3 mile east of Johnston Corners.	Mar. 9, 1964	1140	11	--	--	46	69	--
238-820-A	Near Southburg	On Rt. 78, 0.8 mile south of Five Corners.	Mar. 9, 1964	1525	--	--	--	--	365	4.40
244-819-A	Near Johnsonburg	On Center Line Rd., 1 mile west of Rt. 98.	Mar. 9, 1964	1420	13	.6	19	--	52	--
244-824-A	Near Sheldon	On Center Line Rd., 0.7 mile east of Sheldon.	Mar. 9, 1964	1355	--	--	--	--	264	--
245-849-A	Near Hamburg	On Rt. 62, 0.2 mile south of NYS Thruway.	Aug. 7, 1963	0900	34	46	a/ 37	--	385	6.5
251-809-B	At Linden	On road between Belknap Crossing and West Middleburg, 200 ft east of Little Tonawanda Creek.	Mar. 26, 1963	--	21	2.5	--	--	198	7.5
255-812-D	At Brookville	At gravel pit on Hung Rd., 0.1 mile west of Brookville.	Aug. 9, 1963	1400	15	2.0	116	--	269	7.0

a/ Calcium as Ca

Table 17.--Chemical analyses of streams at high flow

Sampling point mileage index number.--See appendix A.
Remarks.--Additional analyses for some sampling sites included in tables 18, 19, 20 and 21 are indicated by footnotes in the date of collection column.

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
E23-69(0.3)	Tributary to Cattaraugus Creek	Near East Arcade	On East Arcade Road, 0.5 mile south of Rt. 78.	Mar. 9, 1964	1530	12	--	--	59	93	--
E23(61.7)	Cattaraugus Creek	At East Arcade	At bridge on old Rt. 98, 0.2 mile southwest of East Arcade.	a/Mar. 5, 1964	1550	10	3.7	34	--	84	--
				Mar. 9	1540	--	--	--	--	398	3.90
E23-56-15(0.7)	Tributary to Clear Creek	At Freedom	At bridge on Witt Rd., 0.2 mile east of B&O RR.	Mar. 5, 1964	0220	13	3.3	30	--	78	--
E23-56-9(0.6)	do.	At Sandusky	At bridge on a north-south road off Eagle St., east of Sandusky.	Mar. 5, 1964	0200	--	--	--	--	206	4.20
E23(54.7)	Cattaraugus Creek	Near Arcade	At gaging station, at bridge on North Woods Rd.	b,c/Mar. 20, 1963	1230	18	7.0	69	108	170	7.6
				Mar. 5, 1964	0645	12	--	--	76	126	--
E23-50(1.7)	Hosmer Brook	At Chaffee	On Chaffee-Johnstons Corners Rd.	Mar. 9, 1964	1200	17	3.1	48	--	104	--
E23-50-3-1(0.8)	d/Dry Creek	Near Sardinia	On Allen Rd.	Mar. 9, 1964	1145	14	1.7	22	--	58	--
E23-50(0.2)	Hosmer Brook	At Sardinia	At foot bridge, 0.2 mile from mouth.	a/Mar. 9, 1964	1110	21	7.0	82	--	173	--
E23(51.9)	Cattaraugus Creek	do.	At bridge on Buffalo St. below Hosmer Brook.	Mar. 5, 1964	0445	--	--	--	--	218	--
E23-48(14.0)	Elton Creek	At Farmersville Station	At bridge on Older Hill Rd., 0.3 mile southwest of Farmersville Station.	a/Mar. 5, 1964	0305	18	--	--	68	98	--
E23-48-9(0.5)	Tributary to Beaver Lake	Near Farmersville Station	At bridge on Blue St., 1.1 mile north of Siloam Rd.	Mar. 5, 1964	0320	21	3.0	34	--	91	--
E23-48-6(0.1)	Tributary to Elton Creek	At Elton	At bridge on Cheeseman Hill Rd., 0.25 mile east of Elton.	Mar. 5, 1964	0345	11	--	--	36	47	--
E23-48-4-1(0.7)	do.	Near Elton	At bridge on Fisher Blake Rd.	Mar. 5, 1964	0400	19	2.8	30	--	82	--
E23-48-3(1.3)	Lime Lake Outlet	At Delevan	At bridge on Worden Rd.	Mar. 5, 1964	0415	--	--	--	--	128	--
E23-48-3-1(0.3)	Tributary to Lime Lake Outlet	do.	On Worden Rd., 0.35 mile southeast of West St.	Mar. 5, 1964	0435	11	.9	40	--	88	--
E23-48-1-1(0.1)	Tributary to Stony Creek	Near McKinstry Hollow	On Block Rd., 0.25 mile southeast of Vangilder Rd.	Mar. 5, 1964	0450	15	3.2	26	--	61	--
E23-48(0.6)	Elton Creek	At The Forks	At water discharge partial-record station, at bridge on Creek Rd.	b,c/Mar. 20, 1963	1305	19	5.0	69	107	170	8.0
				Mar. 5, 1964	0515	19	--	--	171	254	--
E23-45(0.2)	King Brook	Near Sardinia	At bridge on Creek Rd.	Mar. 5, 1964	0555	--	--	--	--	93	--
E23-43(1.7)	Dresser Creek	do.	At bridge on Middle Rd.	a/Mar. 5, 1964	0745	14	2.9	39	--	93	--
E23-43(0.2)	do.	do.	At bridge on Rt. 39.	a/Mar. 5, 1964	0715	--	--	--	--	230	--
E23(46.9)	Cattaraugus Creek	Near Springville	At bridge off Rt. 39, 0.3 mile east of Van Slyke Rd.	a/Mar. 5, 1964	0640	--	--	--	--	242	--
E23-36(2.7)	Tributary to Cattaraugus Creek	Near Riceville	On Folts Rd.	Mar. 5, 1964	0520	15	1.9	48	--	95	--

a/ Additional analyses included in table 18.
b/ Additional analyses included in table 19.
c/ Analyses made on water decanted from suspended sediment samples.
d/ New York State Department of Health considers this to be a tributary to Dry Creek.

Table 17.--Chemical analyses of streams at high flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
E23-33(7.4)	Buttermilk Creek	At West Valley	At bridge below confluence of two branches.	Mar. 5, 1964	0545	14	4.5	29	--	82	--
E23-33(1.5)	do.	Near Springville	At gaging station, at bridge on Hays Hollow Rd.	a,b,e/Jan. 7, 1963	1040	28	4.5	98	130	222	7.6
E23-33(0.4)	do.	At Edies Siding	At bridge on Thomas Corners Rd.	Mar. 5, 1964	0745	36	--	--	172	266	--
E23-32(3.3)	Spring Brook	At Springville	On North St. east of Sharp St.	Mar. 5, 1964	0934	4.6	3.9	34	--	86	--
E23-30(2.3)	Spooner Creek	Near Springville	At bridge on Rt. 39.	a/Mar. 5, 1964	0852	--	--	--	--	171	--
E23-30-1a(0.6)	Tributary to Spooner Creek	do.	On Belcher Rd., 0.2 mile north of Rt. 39.	Mar. 5, 1964	0830	11	2.4	--	--	67	--
E23-27-6(1.4)	Tributary to Connoisarauley Creek	At Bellow Corners	On Dutch Hill Rd.	Mar. 5, 1964	0705	11	3.6	28	--	74	--
E23-27(6.2)	Connoisarauley Creek	At Ashford Hollow	At bridge on Neff Rd.	a/Mar. 5, 1964	0740	12	6.0	45	--	111	--
E23-27-2(2.5)	Tributary to Connoisarauley Creek	Near Ashford Hollow	At bridge on Connoisarauley Rd., near intersection with Maynard Rd.	Mar. 5, 1964	0747	12	2.9	22	--	67	--
E23-20-13(1.0)	Tributary to East Otto Creek	Near East Otto	On Bowen Rd., 0.2 mile north of East Flats Rd.	Mar. 5, 1964	0802	11	3.8	58	--	121	--
E23-20-12(2.7)	Tributary to South Branch Cattaraugus Creek	Near Otto	On Swamp Rd., 1.1 miles east of North Otto Rd.	Mar. 5, 1964	0900	16	2.4	46	--	92	--
E23-20-12-1(1.7)	do.	do.	On North Otto Rd., 0.2 mile south of Hebner Hill Rd.	Mar. 5, 1964	0915	13	3.9	32	--	82	--
E23-20-12(1.2)	do.	do.	On Colvin Rd., 0.2 mile west of Miller Rd.	Mar. 5, 1964	0830	24	--	--	70	95	--
E23-20(14.4)	South Branch Cattaraugus Creek	do.	At water discharge partial-record station, 0.2 mile upstream from Mansfield Creek.	b/Mar. 5, 1964	0817	19	--	--	106	159	--
E23(17.4)	Cattaraugus Creek	At Gowanda	At bridge on Rt. 39, at gaging station.	a,b,c,f/Mar. 18, 1963	1100	23	5.2	90	134	208	7.2
				c/Mar. 25	1130	--	5.7	--	--	199	7.1
				c/Mar. 26	1000	--	4.2	--	--	199	7.1
				c/Mar. 26	1630	--	3.8	--	--	192	7.5
				c/Mar. 26	2100	--	3.2	--	--	213	7.7
				c/Mar. 27	0030	--	4.2	--	--	214	7.9
				c/Mar. 27	0725	--	3.4	--	--	205	7.7
				c/Mar. 27	1645	--	4.9	--	--	221	7.8
				Mar. 5, 1964	1017	--	--	--	--	245	--
E23-18(1.4)	Grannis Brook	Near Gowanda	On Quaker Rd.	Mar. 5, 1964	1030	--	--	--	--	137	--
E23-16(0.7)	Tributary to Cattaraugus Creek	At Gowanda	At bridge on Rt. 39, 1 mile west of Gowanda.	Mar. 5, 1964	1000	17	5.0	49	--	117	--
E23-6(10.2)	Clear Creek	At Bagdad	At bridge on Bagdad Rd.	Mar. 5, 1964	1044	--	--	--	--	218	--
E23-6-4-10(0.6)	Tributary to North Branch Clear Creek	Near Langford	On Rt. 75, 200 ft north of Genesee Rd.	Mar. 5, 1964	0055	17	5.8	56	--	138	--

a/ Additional analyses included in table 18.
b/ Additional analyses included in table 19.
c/ Analyses made on water decanted from suspended sediment samples.
e/ Bicarbonate (HCO_3) 86 ppm.
f/ Additional analyses included in table 20.

Table 17.--Chemical analyses of streams at high flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
E22(1.2)	Muddy Creek	Near Farnham	At water discharge partial-record station at bridge on Reeves Rd.	Mar. 9, 1964	1340	--	--	--	--	315	--
E21(1.5)	Delaware Creek	Near Angola	At water discharge partial-record station at bridge on Rt. 5.	a/Mar. 9, 1964	1240	--	--	--	--	220	--
E20-15(0.2)	Hussey Gulf Stream	At North Collins	On Rt. 62, 0.7 mile south of North Collins.	b/Mar. 5, 1964	0135	25	8.6	39	--	118	--
E20(12.0)	Big Sister Creek	do.	On Rt. 249, 0.5 mile west of North Collins.	Mar. 5, 1964	0150	21	8.2	43	--	122	--
E20-2(5.9)	Rythus Creek	At Eden	On Hammond Dr., 0.2 mile upstream from Rt. 62 bridge.	Mar. 5, 1964	0205	18	6.7	26	--	85	--
E20-2a(0.3)	Tributary to Rythus Creek	Near Eden	On Eden (New Jerusalem) Rd., 1.3 miles west of Rt. 62.	Mar. 5, 1964	--	19	--	--	82	101	--
E20(2.2)	Big Sister Creek	At Evans Center	At water discharge partial-record station, at bridge on Rt. 5.	Mar. 9, 1964	1215	--	--	--	--	202	--
E15(3.3)	Pike Creek	At Derby	On Pontiac-Derby Rd.	Mar. 5, 1964	0240	21	26	38	--	168	--
E13-58(1.2)	Tributary to Eighteenmile Creek	Near East Concord	On Sharp St., 0.5 mile southeast of Morse Rd.	Mar. 5, 1964	1132	16	1.5	52	--	109	--
E13-57(0.2)	do.	Near Fowlerville	On Snyder Rd., 0.15 mile south of Rt. 219.	Mar. 5, 1964	1156	17	2.9	66	--	132	--
E13(22.8)	Eighteenmile Creek	At Fowlerville	At bridge on Fowler Rd., 0.1 mile west of Rt. 219.	a/Mar. 5, 1964	1225	--	--	--	--	173	--
E13-27(0.5)	Anthony Gulf Stream	At Patchin	On Rt. 219.	Mar. 5, 1964	1305	17	3.2	28	--	78	--
E13(15.3)	Eighteenmile Creek	At No. Boston	At gaging station at bridge on Zimmerman Rd.	b,c/Mar. 20, 1963 Mar. 4, 1964	1440 2310	24 28	7.5 --	64 --	104 170	164 259	7.6 --
E13-8(1.6)	Neuman Creek	Near Hamburg	On Newton Rd., 0.8 mile east of McKinley Pkwy.	Mar. 4, 1964	2255	22	10	56	--	146	--
E13-6(2.6)	Hampton Brook	do.	On Kehe Rd.	Mar. 4, 1964	2325	23	6.1	47	--	122	--
E13-4(18.8)	South Branch Eighteenmile Creek	At Wyandale	On Genesee Rd., 300 ft east of crossroads in Wyandale.	Mar. 5, 1964	0035	16	--	--	95	134	--
E13-4-14(0.1)	Tributary to South Branch Eighteenmile Creek	Near New Oregon	On New Oregon Rd., 100 ft north of Belcher Rd.	Mar. 5, 1964	0020	20	6.0	46	--	132	--
E13-4(2.9)	South Branch Eighteenmile Creek	At Eden Valley	At water discharge partial-record station, at bridge 300 ft upstream from Rt. 62.	b/Mar. 4, 1964	2340	--	--	--	--	188	--
E11(1.3)	Unnamed stream	Near Clifton Heights	On Heltz Rd. 1 mile north of Southwestern Blvd.	Mar. 5, 1964	0255	38	28	57	--	205	--
E3(5.3)	Rush Creek	Near Hamburg	On Bay View Rd. northwest of Armor.	Mar. 4, 1964	2245	--	--	--	--	396	--
E2(3.5)	Smoke Creek	At Lackawanna	At water discharge partial-record station, at bridge on Abbott Rd.	a/Mar. 5, 1964	1000	--	--	--	--	218	--
E1-59-1-4(0.6)	Tributary to Plato Creek	Near Java Village	On Michigan Rd., 3 miles south of Java Village.	Mar. 9, 1964	1305	24	4.0	94	--	207	--

a/ Additional analyses included in table 18.
b/ Additional analyses included in table 19.
c/ Analyses made on water decanted from suspended sediment samples.

Table 17.--Chemical analyses of streams at high flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
E1-59(0.0)	Plato Creek	At Java Village	On Michigan Rd., 0.6 mile south of Java Village.	Mar. 9, 1964	1315	20	3.7	80	--	173	--
E1-58-2-3(0.4)	Tributary to Buffalo Creek	Near Java Center	On Cattaraugus Rd., 200 ft south of Tory Hill Rd.	Mar. 9, 1964	1650	109	21	117	--	311	--
E1-45(0.8)	Glade Creek	At Strykersville	At bridge on Dutch Hollow Rd.	Mar. 9, 1964	1335	21	9.7	64	--	166	--
E1(31.8)	Buffalo Creek	Near Wales Hollow	At gaging station, at bridge on Marlou Rd.	b,c/Mar. 20, 1963	0930	23	5.8	78	120	186	8.0
				Mar. 5, 1964	1440	16	--	--	96	158	--
				Mar. 5	1625	--	--	--	--	179	--
E1-31(2.0)	Stony Bottom Creek	Near Wales Center	On Rt. 20A, 2.2 miles east of Rt.358.	Mar. 5, 1964	1230	15	3.0	40	--	101	--
E1-30(11.6)	Hunter Creek	Near Holland	On Whitney Rd., 0.6 mile east of Hunter Creek Rd.	Mar. 5, 1964	1525	16	7.2	34	--	100	--
E1-30-6(0.3)	Tributary to Hunter Creek	do.	At Crossing of Hunter Creek Rd., 100 ft north of Sanders Rd.	Mar. 5, 1964	1555	34	5.0	49	--	123	--
E1-30(3.7)	Hunter Creek	At Colegrave	At bridge on Center Line Rd.	a/Mar. 5, 1964	1646	16	4.6	55	--	130	--
E1-26(1.6)	Tributary to Buffalo Creek	Near Wales Center	On Rt. 20A, 0.1 mile west of Rt. 78.	Mar. 5, 1964	1755	13	3.1	34	--	84	--
E1(10.4)	Buffalo Creek	At Gardenville	At bridge on Union Rd., 700 ft upstream from gaging station.	b,g/Mar. 5, 1964	0900	34	--	--	204	324	--
E1-6(35.4)	Cayuga Creek	At Toziers	On Center Line Rd., 0.2 mile east of Toziers Corners.	Mar. 9, 1964	1405	17	4.0	50	--	120	--
E1-6-30-4(0.3)	French Brook	At Bennington	On Rt. 354, 0.5 mile east of Rt. 77.	Mar. 5, 1964	1620	--	--	--	--	194	4.05
E1-6(24.9)	Cayuga Creek	At Folsomdale	On Loomis Rd.	Mar. 5, 1964	1310	--	--	--	--	141	--
E1-6-7-7(0.2)	Tributary to Little Buffalo Creek	Near Marilla	At culvert on Bullis Rd., at intersection with Town Line Rd.	a/Mar. 5, 1964	0545	--	--	--	--	156	--
E1-4-15-23(0.8)	Graff Brook	At East Concord	On Allen Rd., 0.1 mile northeast of Rt. 240.	Mar. 5, 1964	1015	11	3.3	30	--	79	--
E1-4-15(15.3)	West Branch Cazenovia Creek	At Footes	At private bridge off Rt. 240, 0.2 mile south of Footes Rd.	a/Mar. 5, 1964	1043	15	3.7	64	--	137	--
E1-4-15-19(0.1)	Crump Brook	Near Glenwood	On Rt. 240.	Mar. 5, 1964	1103	--	--	--	--	143	--
E1-4-14(18.2)	h/Tributary to East Branch Cazenovia Creek	At Protection	On Miller Rd., 0.2 mile east of Penn. RR.	Mar. 9, 1964	1250	17	8.4	60	--	149	--
E1-4-14(13.9)	East Branch Cazenovia Creek	At Holland	On Glenwood-Holland Rd.	Mar. 5, 1964	1442	--	--	--	--	177	--
E1-4-14(8.1)	do.	At South Wales	At water discharge partial-record station, at bridge on Darling Rd.	b,c/Mar. 20, 1963	1050	22	11	56	94	165	7.7
				Mar. 5, 1964	1708	25	7.0	68	--	153	--
E1-4(4.1)	Cazenovia Creek	At Ebenezer	At gaging station at bridge on Ridge Rd.	a,b,c/Mar. 20, 1963	1630	26	12	68	116	188	7.9
				Mar. 5, 1964	0940	--	--	--	--	223	--
0158-15-7(0.4)	Tributary to Scajaquada Creek	At Lancaster	On Rt. 78.	Mar. 5, 1964	0825	--	--	--	--	364	--

a/ Additional analyses included in table 18.
b/ Additional analyses included in table 19.
c/ Analyses made on water decanted from suspended sediment samples.
g/ Additional analyses included in table 21.
h/ New York State Department of Health considers this to be the headwaters of East Branch Cazenovia Creek.

Table 17.--Chemical analyses of streams at high flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
0158-12(106.0)	Tonawanda Creek	At Southburg	On Rt. 98, south of Sheer Rd.	Mar. 5, 1964	1318	11	2.2	49	--	111	--
0158-12-77(0.2)	East Fork Tonawanda Creek	Near North Java	At bridge on Rt. 98.	Mar. 9, 1964	1445	--	--	--	--	248	--
0158-12(100.6)	Tonawanda Creek	Near Johnsonburg	At water discharge partial-record station, at bridge on Rt. 98.	b/Mar. 5, 1964 Mar. 9	1247 1430	-- 18	-- 3.4	-- 85	-- --	205 178	-- --
0158-12-66(0.1)	Stony Brook	At Varysburg	At bridge on Rt. 20A.	a/Mar. 5, 1964 Mar. 5	0445 1725	-- 18	-- 5.8	-- 78	-- --	194 160	-- --
0158-12-46-2(1.9)	Tributary to Crow Creek	At Attica Center	On Baker Rd., 0.1 mile north of Rt. 238.	Mar. 5, 1964	1100	14	4.4	34	--	89	--
0158-12-41(0.1)	Tannery Brook	At Attica	At bridge on Rt. 98.	a/Mar. 5, 1964 Mar. 5	0415 1705	-- 29	-- 8.5	-- 79	-- --	184 173	-- --
0158-12-39-3(1.2)	Baker Brook	Near Dale	On Brewer Rd., 2.7 miles north of Attica Center.	Mar. 5, 1964	1140	16	4.3	60	--	132	--
0158-12-33a(1.8)	Tributary to Tonawanda Creek	At Brookville	On Hung Rd., 0.2 mile northwest of Brookville.	Mar. 5, 1964	0526	--	--	--	--	289	--
0158-12-32-14(0.3)	Tributary to Little Tonawanda Creek	Near Dale	On Lower Dale Rd., 0.3 mile southeast of Millers Crossing.	Mar. 5, 1964	0930	17	3.8	53	--	129	--
0158-12-32-9(0.2)	Dusing Gulf Stream	do.	On Dale Rd., 1.5 miles north of Dale.	Mar. 5, 1964	0905	17	3.1	78	--	167	--
0158-12-32-8(1.8)	Middlebury Brook	Near West Middlebury	At bridge, 0.6 mile east of West Middlebury at Dutton Hill.	Mar. 5, 1964	--	19	--	--	104	151	--
0158-12-32(9.4)	Little Tonawanda Creek	At Linden	At gaging station at bridge in Linden.	b/Mar. 5, 1964	0750	19	--	--	100	152	--
0158-12-32-4(0.0)	Tributary to Little Tonawanda Creek	Near Linden	On Rt. 20, east of bridge over Little Tonawanda Creek.	Mar. 5, 1964	0718	--	--	--	--	756	--
0158-12-32-1(0.7)	do.	Near East Alexander	On Putnam Rd., 1.5 miles northeast of East Alexander.	Mar. 5, 1964	0445	28	6.9	98	--	209	--
0158-12-31b(0.2)	Tributary to Tonawanda Creek	Near Batavia	On Creek Rd., 0.5 mile south of WBTA radio tower and 0.1 mile east of Tonawanda Creek.	Mar. 5, 1964	0410	32	--	--	187	264	--
0158-12-31a(2.9)	do.	Near North Alexander	On Rt. 98, 0.3 mile south of Cookson Rd.	Mar. 5, 1964	0630	--	--	--	--	237	--
0158-12(69.2)	Tonawanda Creek	At Batavia	At gaging station, 500 ft upstream from bridge on Walnut St.	b,c/Mar. 18, 1963 c/Mar. 20 Mar. 5, 1964	1905 0710 0320	19 24 33	8.5 9.8 --	90 102 --	144 154 230	217 240 356	7.4 7.7 --
0158-12-25-1(0.3)	Tributary to Tonawanda Creek	At North Pembroke	On Beckwith Rd., 0.4 mile east of Maple St.	Mar. 5, 1964	--	33	--	--	176	265	--
0158-12-22a(0.1)	do.	Near Indian Falls	On Indian Falls Rd., east-southeast of Indian Falls.	Mar. 5, 1964	0155	--	--	--	--	267	--
0158-12-20a(0.0)	do.	At Indian Falls	On Christie Rd., 100 ft east of Rt. 77.	Mar. 5, 1964	0100	28	8.5	128	--	269	--
0158-12(46.9)	Tonawanda Creek	Near Alabama	At gaging station, at bridge on Meadville Rd.	b,c/Mar. 21, 1963 Mar. 5, 1964	1020 0450	32 47	13 --	124 --	176 260	276 420	8.2 --
0158-12-14(0.5)	Tributary to Tonawanda Creek	Near Swifts Mills	At bridge on Brunning Rd., 0.2 mile from Scotland Rd.	a/Mar. 5, 1964	0255	--	--	--	--	238	--

a/ Additional analyses included in table 18.
b/ Additional analyses included in table 19.
c/ Analyses made on water decanted from suspended sediment samples.

Table 17.--Chemical analyses of streams at high flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
0158-12-11-2(0.5)	Tributary to Ledge Creek	Near Akron	On Tesnow Rd., 0.6 mile north of Sparling Rd.	Mar. 5, 1964	0230	--	--	--	--	458	--
0158-12-11(29.5)	Murder Creek	At Darien	At bridge on Griswold Rd., 0.2 mile south of Rt. 238.	a/Mar. 5, 1964	0330	--	--	--	--	137	--
				Mar. 5	1645	23	5.7	44	--	118	--
0158-12-11-1(29.5)	Tributary to Murder Creek	Near Corfu	On Boyce Rd., 0.1 mile north of Rt. 33.	Mar. 5, 1964	0130	--	--	--	--	361	--
				Mar. 5	1435	--	--	--	--	279	--
0158-12-11-1(12.4)	Murder Creek	At Pembroke	At Rt. 5 (Main St.) crossing.	Mar. 5, 1964	1450	--	--	--	--	278	--
0158-12-11-1-3a(0.6)	Tributary to Murder Creek	do.	At Rt. 5 (Main St.) crossing, 0.9 mile west of Pembroke.	Mar. 5, 1964	1510	26	22	62	--	184	--
0158-12-10(2.0)	Tributary to Tonawanda Creek	At Sand Hill	On Fletcher Rd., 0.1 mile northeast of Rapids Rd.	Mar. 5, 1964	0755	--	--	--	--	272	--
0158-12-9-1(2.4)	Tributary to Beeman Creek	Near Hunts Corners	On Keller Rd., 0.25 mile east of Strickler Rd.	Mar. 5, 1964	0815	--	--	--	--	324	--
0158-12(19.5)	Tonawanda Creek	At Rapids	At gaging station, at bridge at Rapids.	b,c/Mar. 19, 1963	1655	35	16	114	176	281	7.8
				Mar. 5, 1964	0730	94	--	--	314	467	--
0158-12-8(15.1)	Mud Creek	At Wolcottsville	On Royalton Center Rd., 0.5 mile north of Wolcottsville.	Mar. 5, 1964	0530	33	--	--	123	170	--
0158-12-8-4b(0.3)	Tributary to Mud Creek	do.	At Wolcottsville Rd. crossing, 0.2 mile north of Fisk Rd.	Mar. 5, 1964	0520	35	5.4	72	--	174	--
0158-12-8-4a(2.2)	do.	Near Wolcottsville	On Royalton Center Rd., 1.9 miles north-northwest of Wolcottsville.	Mar. 5, 1964	0545	27	7.3	49	--	133	--
0158-12-8-4(0.4)	do.	Near Rapids	On Simms Rd., 0.4 mile east of Riddle Rd.	Mar. 5, 1964	0615	19	3.5	33	--	89	--
0158-12-8-2(0.2)	do.	At Raymond	On Rapids Rd., 0.3 mile southeast of Minnick Rd.	Mar. 5, 1964	0715	40	9.0	94	--	217	--
0158-12-6-4a(0.1)	Tributary to Got Creek	Near Clarence Center	On Roll Rd., east of Newhouse Rd.	Mar. 5, 1964	0850	--	--	--	--	1,100	--
0158-12-6-3-1(1.3)	Tributary to Black Creek	At Swormville	On Transit Rd. (Rt. 78), 0.1 mile north of Lapp Rd.	Mar. 5, 1964	0920	34	7.8	56	--	148	--
0158-12-3a(2.8)	Tributary to Tonawanda Creek	Near Wendelville	On Meyer Rd., 0.2 mile east of Beach Ridge Rd.	Mar. 5, 1964	1230	46	17	128	--	300	--
0158-12-3(10.0)	Bull Creek	Near Mapleton	On road north from Constock Corners, 0.2 mile north of NYC RR.	Mar. 5, 1964	1100	42	--	--	168	228	--
0158-12-3(7.1)	do.	At Mapleton	At bridge on Mapleton Rd., 0.35 mile east of Mapleton.	a/Mar. 5, 1964	1045	48	18	112	--	272	--
0158-12-3-3(0.9)	Tributary to Bull Creek	do.	On Mapleton Rd., 0.6 mile west of Aiken Rd.	Mar. 5, 1964	1030	--	--	--	--	356	--
0158-12-3-1a(0.8)	Tributary to Sawyer Creek	Near St.Johnsbury	On Nash Rd., 0.9 mile north of Rt.62.	Mar. 5, 1964	1130	19	18	107	--	268	--
0158-12-3(1.4)	Bull Creek	At Hoffman	On Town Line Rd., 1 mile south of Killean Rd.	a,b/Mar. 5, 1964	1005	37	19	85	--	239	--

a/ Additional analyses included in table 18.
b/ Additional analyses included in table 19.
c/ Analyses made on water decanted from suspended sediment samples.

Table 17.--Chemical analyses of streams at high flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Dissolved solids at 180°C (ppm)	Specific conductance (micromhos at 25°C)	pH
0158-12-1(43.1)	Elevenmile Creek	Near Darien Center	Near Seven Day Rd. on County Line Road.	Mar. 5, 1964	1355	22	4.7	40	--	106	--
0158-12-1-18-1(1.2)	Durkee Creek	Near Alden	On County Line Rd., near Seven Day Rd.	Mar. 5, 1964	1535	18	--	--	74	100	--
				Mar. 5	0245	45	3.0	36	--	92	--
0158-12-1(28.8)	Ellicott Creek	At Mill Grove	At bridge on Ellicott Rd., at gaging station.	b,c/Mar. 20, 1963	0805	25	9.2	87	142	209	8.0
				Mar. 5, 1964	0640	40	--	--	140	212	--
0158-12-1(14.1)	do.	At Williamsville	At gaging station, at bridge on Wehrle Dr.	a,b,c/Mar. 19, 1963	0830	33	13	92	150	235	7.4
				Mar. 5, 1964	0730	35	--	--	192	300	--
0158-12-1-5a(0.6)	Drainage Ditch	Near Getzville	On N. French Rd., 0.5 mile east of Sweet Home Rd.	Mar. 5, 1964	0945	48	8.1	100	--	226	--
0158-12-7-1(3.2)	Tributary to Barge Canal	Near Lockport	On Beattie Ave., 0.1 mile north of Hamm Rd.	Mar. 5, 1964	0655	--	--	--	--	324	--

a/ Additional analyses included in table 18.
b/ Additional analyses included in table 19.
c/ Analyses made on water decanted from suspended sediment samples.

Table 18.--Chemical analyses of streams at low flow

Sampling point mileage index number.--See appendix A.

Remarks.--Additional analyses for some sampling sites included in tables 17, 19 & 20, and are indicated by footnotes in the date of collection column.

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)	pH
E23(65.7)	Cattaraugus Creek	At East Java	At bridge on Chaffee Rd.	July 2, 1963	1400	15	6.8	91	196	7.5
E23(61.7)	do.	At East Arcade	At bridge on old Rt. 98, 0.2 mile southwest of East Arcade.	a/July 2, 1963	1430	--	--	--	286	7.9
				June 26, 1964	1128	--	--	--	270	7.3
E23-67(0.7)	Spring Brook	do.	At bridge on Allen Brook Rd.	July 2, 1963	1455	27	5.8	140	341	8.3
E23(56.7)	Cattaraugus Creek	At Arcade	At bridge on Rt. 98, 0.1 mile upstream from Clear Creek.	b/July 2, 1963	1530	17	8.8	136	288	8.1
E23-56(7.5)	Clear Creek	At Freedom	At bridge on Scott Rd., east of Freedom.	July 4, 1963	1340	8.4	1.7	80	169	8.0
E23-56(6.0)	do.	Near Freedom	At bridge on Rt. 98, west of Freedom.	July 4, 1963	1435	25	13	126	305	8.5
E23-56(4.7)	do.	At Sandusky	At bridge on Rt. 98.	July 4, 1963	1425	--	--	--	282	8.1
E23-56-11(0.1)	Skim Lake Outlet	do.	At bridge on Rt. 98.	July 4, 1963	1615	--	--	--	264	8.0
E23-(54.7)	Cattaraugus Creek	Near Arcade	At gaging station, at bridge on North Woods Rd.	a,b/July 2, 1963	1605	18	9.7	138	295	8.0
E23-51(0.8)	Tributary to Cattaraugus Creek	At Cheery Tavern near Yorkshire	At bridge on Rt. 39.	July 4, 1963	1110	31	17	241	491	7.6
E23-50(1.0)	Hosmer Brook	At Sardinia	do.	a/July 4, 1963	0920	--	--	--	413	7.9
				July 12	1315	--	--	--	393	8.3
E23-50(0.2)	do.	do.	At foot bridge, 0.2 mile from mouth.	July 4, 1963	1000	31	10	212	411	8.0
				May 7, 1964	1415	33	10	201	410	7.8
				July 22	0957	37	9.0	212	424	7.4
				Sept 8	1130	31	8.2	148	324	8.0
E23-48(13.0)	Elton Creek	Near Farmersville Station	At bridge on Older Hill Rd., 0.8 mile southwest of Farmersville Station.	July 4, 1963	1250	15	8.8	111	279	7.8
E23-48(8.1)	do.	At Elton	At bridge on Marble Springs Rd.	July 4, 1963	1340	20	6.0	120	314	8.3
E23-48(3.6)	do.	At Delevan	At bridge on Mill St.	July 4, 1963	1220	--	--	--	354	8.2
				July 12	1410	--	--	--	310	8.2
E23-48-3(4.8)	Lime Lake Outlet	At Lime Lake	At foot bridge at lake outlet	July 4, 1963	1310	--	--	--	288	8.4
E23-48-3(0.4)	do.	At Delevan	At bridge on Mill St.	July 4, 1963	1240	--	--	--	280	7.7
E23-48(0.6)	Elton Creek	At The Forks	At highway bridge.	a,b/July 5, 1963	1325	25	5.6	139	316	7.8
E23-43(1.7)	Dresser Creek	Near Sardinia	At water discharge partial-record station, at bridge on Creek Rd.	a/July 4, 1963	0855	25	2.8	137	276	7.9
E23-43(0.2)	do.	At Sardinia	At bridge on Rt. 39.	a/July 4, 1963	0830	43	3.0	180	357	7.9
E23-42(1.8)	Hyler Creek	Near Sardinia	At bridge on Middle Rd.	July 4, 1963	1110	19	3.2	75	173	8.0
E23-42(0.0)	do.	do.	At bridge on Rt. 39.	July 4, 1963	1030	35	4.0	134	272	8.1
E23(46.9)	Cattaraugus Creek	Near Springville	At bridge off Rt. 39, 0.3 mile east of Van Slyke Rd.	a/July 5, 1963	1250	24	8.2	156	319	8.3
E23-33(5.0)	Buttermilk Creek	At Riceville Station	At bridge on Fox Valley Rd.	b/July 4, 1963	1700	27	10	141	310	8.1

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 19.

Table 18.--Chemical analyses of streams at low flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)	pH
E23-33-5(1.0)	Gooseneck Creek	At Riceville	At bridge on Goose Neck Rd.	July 4, 1963	1610	14	2.5	104	215	8.2
E23-33(1.5)	Buttermilk Creek	Near Springville	At gaging station, at bridge on Hayes Hollow Rd.	a/July 4, 1963	0915	33	50	207	445	7.3
E23-32(4.0)	Spring Brook	do.	At bridge on Middle Rd.	July 4, 1963	1115	--	--	--	363	8.1
				July 12,	1200	--	--	--	385	8.1
E23-32(2.6)	do.	At Springville	At foot bridge, upstream from Maple St.	July 4, 1963	1010	25	19	188	384	7.9
				May 7, 1964	1145	26	14	192	399	7.5
				July 2	0937	25	14	188	399	7.6
				Sept. 9	0825	30	16	200	414	7.7
E23-32(0.1)	do.	At Felton Bridge near Springville	500 ft upstream from Cattaraugus Creek	July 4, 1963	1030	--	--	--	428	7.9
E23-30(4.8)	Spooner Creek	At Concord	At bridge on Concord Rd.	May 7, 1964	1320	22	2.0	121	249	7.7
				July 21	1110	26	3.6	133	273	7.8
				Sept. 2	1000	27	4.0	139	287	7.9
E23-30(2.3)	do.	Near Springville	At bridge on Rt. 39.	a/July 4, 1963	0910	--	--	--	374	8.1
E23-30(0.4)	do.	Near Scobey Bridge	At bridge on Tefft Rd.	July 4, 1963	1215	54	6.0	213	414	8.1
E23-28(0.1)	Derby Brook	At Frye Bridge near Springville	At bridge on Zoar Valley Rd.	July 4, 1963	1330	--	--	--	418	8.4
E23-27(6.2)	Connoisarauley Creek	At Ashford Hollow	At bridge on Neff Rd.	a/July 4, 1963	1345	18	111	218	525	7.0
E23-27(0.1)	do.	At Frye Bridge near Springville	At bridge on Hammond Hill Rd.	July 4, 1963	1300	37	15	177	378	8.0
E23-25(0.3)	Coon Brook	Near Zoar Bridge near Springville	At bridge on Zoar Valley Rd.	July 4, 1963	1150	80	12	211	419	7.2
E23(26.9)	Cattaraugus Creek	At Zoar Bridge near Gowanda	At bridge on road to Otto off Zoar Valley Rd.	b/July 5, 1963	1700	32	10	160	339	7.8
E23-21(0.2)	Waterman Brook	Near Zoar Bridge near Springville	At first bridge upstream from mouth.	July 4, 1963	1500	44	5.7	189	383	8.2
				July 12	1105	--	--	--	381	8.1
E23-20(18.5)	South Branch Cattaraugus Creek	At East Otto	At bridge on north side of East Otto.	July 5, 1963	1540	--	--	--	362	7.3
E23-20-12(0.6)	Tributary to South Branch Cattaraugus Creek	Near Otto	At bridge on Miller Rd., 0.3 mile south of Colvin Rd.	July 5, 1963	1500	--	--	--	379	6.9
E23-20(14.4)	South Branch Cattaraugus Creek	do.	At water discharge partial-record station, 0.2 mile upstream from Mansfield Creek.	a,b/July 5, 1963	1430	27	9.0	158	336	7.4
E23-20-11(5.5)	Mansfield Creek	At Maples	At bridge on Kent Rd., 0.6 mile east of Maples.	July 4, 1963	1430	21	6.2	127	262	7.9
E23-20-11(1.8)	do.	Near Eddyville	At bridge on Maples Road, 0.6 mile east of Scott Corners Rd.	July 5, 1963	1320	--	--	--	365	7.9
				May 18, 1964	1205	21	4.0	118	225	7.7
				July 21	1255	22	6.0	116	252	7.9
				Sept. 3	1325	24	6.2	124	269	7.9
E23-20-11-2(2.0)	Jersey Hollow Brook	Near Otto	At bridge on Jersey Hollow Rd.	July 5, 1963	1245	--	--	--	302	7.5
E23-20-7(0.3)	Gowan Hollow Brook	At Cattaraugus	At bridge at east side of Cattaraugus.	July 5, 1963	1000	98	31	186	440	6.6

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 19.

Table 18.--Chemical analyses of streams at low flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)	pH
E23-20(9.4)	South Branch Cattaraugus Creek	At Cattaraugus	Near south end of Skinner Hollow, 0.25 mile downstream from confluence with Gowan Hollow Brook.	July 5, 1963	1055	--	--	--	336	8.2
E23-20(1.2)	do.	At Forty Bridge near Gowanda	At bridge on Forty Rd.	July 4, 1963	1605	126	26	187	416	6.4
E23(19.4)	Cattaraugus Creek	Above Gowanda	At southeast side of Gowanda, 0.1 mile downstream from Point Peter Brook	b/July 5, 1963	1030	24	7.4	159	339	7.6
E23(17.4)	Cattaraugus Creek	At Gowanda	At bridge on Rt. 39, at gaging station.	a,b,c,d/July 26, 1962 July 5, 1963	1215 0930	-- 41	32 37	173 177	476 462	7.3 7.1
E23-6-4(0.6)	North Branch Clear Creek	Near Lawtons	At bridge on Taylor Hollow Rd.	July 2, 1963	1600	--	--	--	369	8.3
E23-6(0.9)	Clear Creek	Near Iroquois	At water discharge partial-record station at bridge on Rt. 438.	b/July 2, 1963	1430	54	11	204	429	7.8
E23-5(1.8)	Big Indian Creek	Near Versailles	At bridge on Watertown Rd.	July 2, 1963	1320	109	39	136	416	6.9
E23(1.6)	Cattaraugus Creek	At Irving	At bridge on Rt. 20	July 5, 1963 July 12	1300 0850	39 --	18 --	184 --	407 409	7.4 7.7
E23(0.0)	Cattaraugus Creek	Near Irving	At mouth.	e/Aug. 27, 1957	0900	--	13	194	398	7.8
E21(1.5)	Delaware Creek	Near Angola	At bridge on Rt. 5.	a/July 2, 1963	1120	45	24	173	403	7.7
E20-2(0.8)	Rythus Creek	Near Pontiac	At bridge on Pontiac Rd.	July 2, 1963	1000	48	39	173	439	7.7
E20(2.2)	Big Sister Creek	At Evans Center	At water discharge partial-record station, at bridge on Rt. 5.	a,b/July 2, 1963	1030	60	99	141	675	7.1
E15(0.5)	Pike Creek	Near Highland-on-the-Lake	At bridge on Lake Shore Rd.	July 2, 1963	0850	--	--	--	614	7.5
E13(25.5)	Eighteenmile Creek	Near Fowlerville	On Rt. 219, 0.5 mile southeast of Snyder Rd.	July 4, 1963 July 12	1445 1152	36 --	6.3 --	183 --	361 381	8.1 8.3
E13(22.8)	do.	At Fowlerville	At bridge on Fowler Rd., 0.1 mile west of Rt. 219.	a/July 4, 1963	1525	57	15	196	423	7.4
E13(20.6)	do.	At Boston	At bridge on Pfarner Rd.	July 4, 1963	0845	--	--	--	419	8.1
E13(15.3)	do.	At North Boston	At gaging station, at bridge on Zimmerman Rd.	a,b/July 2, 1963	1330	43	19	168	387	7.6
E13-9(0.1)	Chestnut Ridge Drainage	Near North Boston	At bridge on Rt. 219.	July 4, 1963	0840	74	17	244	507	7.7
E13-8(0.3)	Neuman Creek	At Hamburg	do.	July 4, 1963	0800	--	--	--	599	7.0
E13-6(1.3)	Hampton Brook	Near Hamburg	At intersection of E. Eden Rd. and Ekhard Rd.	July 2, 1963	--	--	--	--	374	7.5
E13-4(15.5)	South Branch Eighteenmile Creek	At New Oregon	On New Oregon Rd.	July 2, 1963	1400	--	--	--	329	8.0
E13-4(11.0)	do.	At Clarksburg	At bridge on New Oregon Rd., north of Clarksburg.	July 2, 1963	1300	--	--	--	367	7.5
E13-4(2.9)	do.	At Eden Valley	At water discharge partial-record station, at bridge 300 ft upstream from Rt. 62.	a,b/July 2, 1963	1115	55	13	165	379	7.7

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 19.
c/ Additional analyses included in table 20.
d/ Bicarbonate (HCO_3) 172 ppm.
e/ Bicarbonate (HCO_3) 194 ppm, Nitrate (NO_3) 9.3 ppm.

Table 18.--Chemical analyses of streams at low flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)	pH
E13(0.5)	Eighteenmile Creek	At Highland-on-the-Lake	At water discharge partial-record station, at bridge on Lake Shore Rd.	b/July 2, 1963	0840	70	80	215	629	7.3
E2-2(0.6)	Tributary to Smoke Creek	Near Orchard Park	At bridge on Mile Strip Rd.	July 4, 1963	1705	101	36	296	649	7.8
E2-1(4.5)	South Branch Smoke Creek	do.	At bridge on Rt. 20.	July 2, 1963 July 4	1350 0700	55 63	74 67	183 243	579 694	9.4 7.5
E2(3.5)	Smoke Creek	At Lackawanna	At bridge on Abbott Rd.	a/July 2, 1963	1250	79	53	244	623	7.4
E1(42.2)	Buffalo Creek	Near Java Village	At bridge on Sheehe Rd., at intersection of Whaley Rd.	July 5, 1963	1420	184	27	260	533	6.2
E1-59(0.3)	Plato Brook	do.	150 ft above pond off Michigan Rd., 0.3 mile upstream from mouth.	May 5, 1964 July 22 Sept.10	1525 0825 1250	37 41 46	4.6 5.0 9.7	152 240 244	315 471 492	8.2 8.0 7.8
E1-58(0.0)	Tributary to Buffalo Creek	At Java Village	At bridge on Michigan Rd.	July 5, 1963	1330	36	34	210	429	7.4
E1-55(3.2)	Beaver Meadow Creek	Near Java Center	At bridge on Cattaraugus Rd.	July 4, 1963	1720	66	20	184	384	7.0
E1-55-1(0.8)	Tributary to Beaver Meadow Creek	do.	At bridge on Welch Rd., 0.15 mile east of McNulty Rd.	July 4, 1963	1625	66	58	184	417	6.5
E1-55(0.1)	Beaver Meadow Creek	At Java Village	At bridge on Rt. 78.	b/July 4, 1963	1500	21	6.0	156	305	8.0
E1(40.9)	Buffalo Creek	do.	At bridge on Whitney Rd.	b/July 5, 1963	1215	33	6.0	177	356	7.8
E1-45(0.6)	Glade Creek	At Strykersville	At bridge on Rt. 78.	July 4, 1963	1340	71	20	180	400	7.5
E1-40(2.7)	Sheldon Creek	At Dutch Hollow	At bridge on Center Line Rd.	July 5, 1963	1035	67	26	121	310	6.5
E1-40(0.2)	do.	Near Strykersville	At bridge on Rt. 78.	July 4, 1963	1300	--	--	--	314	7.8
E1(31.8)	Buffalo Creek	Near Wales Hollow	At gaging station, at bridge on Marlou Rd.	a,b/July 2, 1963	1240	41	10	190	393	7.4
E1-31(0.1)	Stony Bottom Creek	Near Wales Center	At culvert on Rt. 78.	July 5, 1963	0830	--	--	--	360	7.9
E1-30(9.8)	Hunter Creek	Near Holland	At bridge on Sanders Rd.	July 2, 1963	1055	80	12	231	470	7.9
E1-30(3.7)	do.	At Colegrave	At bridge on Center Line Rd.	a/July 2, 1963	1420	--	--	--	499	7.4
E1-22(0.2)	Tributary to Buffalo Creek	Near East Aurora	At culvert on West Blood Rd., 2,200 ft east of Ostrander Rd.	July 4, 1963	1210	165	33	367	727	6.9
E1-21(0.5)	do.	do.	On West Blood Rd., 800 ft east of Ostrander Rd.	July 4, 1963 May 18, 1964 July 22 Sept. 8	1135 1545 1202 1435	-- 33 30 36	-- 15 18 18	-- 251 258 268	504 494 499 525	7.3 8.0 8.4 8.1
E1-15(4.1)	Pond Brook	do.	At bridge on Jamison Rd.	July 4, 1963	1045	64	27	231	491	6.9
E1-15(0.0)	do.	At Elma	At bridge on Chair Factory Rd., East of Bowen Rd.	July 4, 1963 July 12	1325 1425	-- --	-- --	-- --	413 433	8.6 9.5
E1(18.0)	Buffalo Creek	do.	At bridge on Bowen Rd.	b/July 5, 1963 July 12	1320 1452	53 --	12 --	173 --	378 390	7.5 8.2
E1(13.8)	do.	At Blossom	At bridge on Blossom Rd.	July 4, 1963	1440	--	--	--	363	8.6
E1(10.4)	do.	At Gardenville	At bridge on Union Rd., 700 ft upstream from gaging station.	a,b/July 5, 1963	1030	55	12	163	359	7.4
E1-6(30.6)	Cayuga Creek	Near Persons Corners	At bridge on Rt. 77	July 5, 1963	0915	--	--	--	353	8.2

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 19.

Table 18.--Chemical analyses of streams at low flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)	pH
E1-6-30(2.2)	Right Branch Cayuga Creek	At Bennington	At bridge on Rt. 77	July 5, 1963 July 12	1000. --	-- --	-- --	-- --	341 761	7.8 7.7
E1-6(23.3)	Cayuga Creek	At Cowlesville	At bridge on Urf Rd.	b/July 5, 1963	1415	48	24	190	423	7.8
E1-6(20.9)	do.	Near Williston	At bridge on Rt. 354 (Clinton Rd.) above waste disposal outlet.	July 4, 1963	1050	--	--	--	401	8.0
E1-6(20.9)	do.	do.	At bridge on Rt. 354 (Clinton Rd.) below waste disposal outlet.	July 4, 1963	1045	--	--	--	390	8.0
E1-6-20(2.6)	Tributary to Cayuga Creek	Near Cowlesville	At bridge on County Line Rd.	July 5, 1963	1230	37	18	82	232	7.2
E1-6-20(0.7)	do.	do.	At bridge on Rt. 239.	July 5, 1963	1045	--	--	--	357	7.3
E1-6-7(9.3)	Little Buffalo Creek	At Marilla	At bridge on Marilla-Williston Rd.	July 4, 1963	0845	37	30	160	362	7.5
E1-6-7-10(0.1)	Tributary to Little Buffalo Creek	do.	At mouth, off Bullis Rd., northeast of Marilla.	July 4, 1963	1000	74	11	255	503	7.9
E1-6-7-7(0.2)	do.	Near Marilla	At culvert on Bullis Rd., at intersection with Town Line Rd.	a/July 4, 1963	0955	--	--	--	351	8.0
E1-6(11.0)	Cayuga Creek	Near Lancaster	At bridge on Bowen Rd., 700 ft upstream from gaging station.	b/July 5, 1963	1420	52	13	168	375	7.6
E1-6-6(0.5)	Plum Bottom Creek	At Lancaster	At bridge on Holland Avenue.	July 5, 1963 July 12	1005 1536	53 --	320 --	265 --	1,420 1,180	7.7 7.7
E1-4-15-22-3(0.1)	Tributary to Spencer Brook	Near Scotts Corners	At bridge on Allen Rd.	July 4, 1963	1010	78	15	104	399	7.8
E1-4-15(15.3)	West Branch Cazenovia Creek	At Footes	At bridge off Rt. 240, 0.2 mile south of Footes Rd.	a/July 4, 1963	1355	--	--	--	329	7.6
E1-4-15-21(0.0)	Sprague Brook	Near Glenwood	At bridge on Rt. 240.	July 4, 1963 July 12	1335 0938	-- --	-- --	-- --	347 366	8.1 8.2
E1-4-15(10.5)	West Branch Cazenovia Creek	At Colden	At upstream bridge on Rt. 240.	July 4, 1963 July 12	1005 1042	49 --	9.1 --	140 --	377 476	8.0 7.6
E1-4-15(5.4)	do.	At West Falls	1,400 ft upstream from bridge in West Falls.	July 4, 1963	1125	--	--	--	366	8.7
E1-4-15-4(0.2)	Tributary to West Branch Cazenovia Creek	At Taylorshire	At bridge on Grover Rd.	July 2, 1963	1215	--	--	--	685	7.7
E1-4-15(0.5)	West Branch Cazenovia Creek	Near East Aurora	At water discharge partial-record station, at bridge on Jewett-Holmwood Rd.	b/July 5, 1963	1110	60	14	160	352	7.6
E1-4-14(13.6)	East Branch Cazenovia Creek	At Holland	At bridge on Rt. 16.	July 2, 1963	0945	37	13	183	380	8.0
E1-4-14-20(0.2)	Tributary to East Branch Cazenovia Creek	do	At bridge on Rt. 16, near Partridge Rd.	July 2, 1963	0845	51	2.8	148	303	8.2
E1-4-14(8.1)	East Branch Cazenovia Creek	At South Wales	At water discharge partial-record station, at bridge on Darling Rd.	a,b/July 2, 1963	0730	38	12	146	330	7.3
E1-4-14-4(2.0)	Tannery Brook	At East Aurora	At bridge on Rt. 20A.	July 2, 1963	1530	53	78	253	757	7.2

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 19.

Table 18.--Chemical analyses of streams at low flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)	pH
E1-4(10.4)	Cazenovia Creek	At Spring Brook	At bridge on Northrup Rd.	July 4, 1963	1600	--	--	--	488	9.2
				July 12	--	--	--	--	654	9.3
E1-4(4.1)	do.	At Ebenezer	At gaging station on Ridge Rd.	a,b/July 2, 1963	1515	69	48	190	491	8.8
				July 5	1250	58	51	196	497	8.9
0158-15(11.6)	Scajaquada Creek	At Lancaster	At bridge on Leyard Ave., between NYC and Lehigh RR. tracks.	July 5, 1963	0930	--	--	--	575	7.4
0158-12(100.6)	Tonawanda Creek	Near Johnsonburg	At water discharge partial-record station, at bridge on Rt. 98.	a,b/July 2, 1963	1310	27	5.8	171	338	8.1
0158-12-66(0.1)	Stony Brook	At Varysburg	At bridge on Rt. 20A.	a/July 4, 1963	1435	316	34	130	1,210	2.9
				July 12	1605	42	12	171	364	8.3
0158-12-59(0.2)	Johnson Creek	At Earls	At bridge on Eck Rd.	July 5, 1963	0935	108	54	221	489	6.6
0158-12-41(0.1)	Tannery Brook	At Attica	At bridge on Rt. 98.	a/July 2, 1963	1645	--	--	--	604	6.7
0158-12-39-3(0.2)	Baker Brook	do.	At bridge on Rt. 238	July 4, 1963	1635	60	52	328	659	6.8
0158-12-39-1(0.1)	Tributary to Tonawanda Creek	Near Attica	At bridge, near Attica Rd., east side of Tonawanda Creek, 600 ft south of Stroh Rd.	July 2, 1963	1530	--	--	--	599	--
0158-12(85.6)	Tonawanda Creek	do.	At bridge on Stroh Rd.	b/July 2, 1963	1450	40	10	197	411	7.3
0.58-12-35(0.6)	Tributary to Tonawanda Creek	At Alexander	At bridge on Brookville Rd.	July 2, 1963	1010	23	9.0	270	515	7.6
0158-12-32(15.2)	Little Tonawanda Creek	At Dale	At bridge on Fox Rd.	July 2, 1963	1150	25	6.2	174	350	7.7
0158-12-32-8(0.7)	Middlebury Brook	At West Middlebury	At bridge on West Middlebury Rd.	July 2, 1963	1115	--	--	--	429	8.0
0158-12-32(9.4)	Little Tonawanda Creek	At Linden	At gaging station at bridge in Linden	a,b/July 2, 1963	1100	33	6.4	201	420	7.9
0158-12-32(5.3)	do.	At West Bethany	At bridge on Gilhodly Rd.	July 2, 1963	0935	--	--	--	444	8.0
0158-12-32(4.1)	do.	At East Alexander	At bridge on Creek Rd.	July 2, 1963	--	38	11	190	386	7.8
0158-12-32(1.1)	do.	Near East Alexander	At bridge on Old Creek Rd.	July 2, 1963	0830	--	--	--	419	7.5
0158-12(69.2)	Tonawanda Creek	At Batavia	At gaging station, 500 ft upstream from bridge on Walnut St.	a,b/July 2, 1963	0740	41	12	187	404	7.5
0158-12-28(11.4)	Bowen Creek	Near Alexander	At bridge on Rt. 20.	July 2, 1963	1310	--	--	--	1,300	7.1
0158-12-28(8.0)	do.	do.	At bridge on Dodgeson Rd.	July 2, 1963	1100	91	44	349	714	7.5
0158-12(54.1)	Tonawanda Creek	At Indian Falls	At bridge on Rt. 77.	b/July 2, 1963	--	43	37	238	560	7.6
0158-12(46.9)	do.	Near Alabama	At gaging station, at bridge on Meadville Rd.	a,b/July 2, 1963	1015	84	46	282	670	7.6
0158-12-14(0.5)	Tributary to Tonawanda Creek	Near Swifts Mills	At bridge on Brunning Rd., 0.2 mile west of Scotland.	a/July 2, 1963	0930	1,020	359	1,360	3,020	7.6
0158-12-11-1(29.5)	Murder Creek	At Darien	At bridge on Griswold Rd., 0.2 mile south of Rt. 238.	a/July 2, 1963	1220	61	26	153	370	7.3
0158-12-11-1(26.9)	do.	At Sawens	At bridge on Harper Rd.	July 2, 1963	1145	43	45	199	496	7.8
0158-12-11-1(15.1)	do.	Near Pembroke	At bridge on Cohocton Rd.	July 2, 1963	1415	--	--	--	604	7.7

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 19.

Table 18.--Chemical analyses of streams at low flow (Continued)

Sampling point mileage index number	Stream	Location	Point of collection	Date of collection	Time (hours)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)	pH
0158-12-11-1(13.0)	Murder Creek	At Pembroke	At water discharge partial-record station, at bridge on Lake Rd.	b/July 2, 1963	1330	29	71	300	697	7.4
0158-12-11-1(8.4)	do.	At Akron	In village park.	July 2, 1963	0840	100	74	397	795	7.5
0158-12-11-1-1(0.8)	Beaver Meadow Creek	At Swifts Mills	At bridge on Greenbush Rd.	July 5, 1963	0815	1,190	20	1,410	2,070	7.8
0158-12-9(1.2)	Beeman Creek	Near Hunts Corner	On Rt. 268 at Cedar Swamp Rd.	July 5, 1963	0800	888	22	1,170	1,780	7.5
0158-12(19.5)	Tonawanda Creek	At Rapids	At gaging station, at highway bridge, at Rapids.	a,b/July 2, 1963	0930	240	48	455	950	7.4
0158-12-8(15.1)	Mud Creek	At Wolcottsville	At bridge on Wolcottsville Rd., 0.5 mile north of Wolcottsville.	a/May 6, 1964	1250	89	14	270	529	7.3
0158-12-8(0.5)	do.	At Millersport	At bridge on Rt. 78.	July 2, 1963	1100	--	--	--	562	7.7
0158-12-6-4(3.5)	Got Creek	Near East Amherst	At bridge on Newhouse Rd.	July 2, 1963	1340	1,240	56	1,530	2,360	7.1
0158-12-6-3(1.1)	Black Creek	At Swormville	At bridge on Rt. 78.	July 2, 1963	1135	--	--	--	1,660	7.5
0158-12-6(2.5)	Ransom Creek	Near Swormville	At bridge on Rt. 263.	b/July 2, 1963	1155	1,200	107	1,470	2,360	7.2
				June 26, 1964	1315	1,100	34	1,270	1,940	8.1
				Sept. 21	0900	1,250	81	1,500	2,340	7.5
0158-12-5(0.0)	Tributary to Tonawanda Creek	At Wendelville	At mouth of stream, 0.9 mile east of Wendelville.	July 2, 1963	0930	58	28	132	342	7.6
0158-12-3-3(0.9)	Tributary to Bull Creek	At Mapleton	At bridge on Mapleton Rd., 0.6 mile west of Aiken Rd.	a/July 2, 1963	1100	190	31	450	860	8.0
0158-12-3(1.4)	Bull Creek	At Hoffman	At bridge on Town Line Rd., 1 mile south of Killean Rd.	a,b/July 2, 1963	1015	183	54	448	936	7.5
				May 6, 1964	0930	135	31	332	645	7.2
				July 23	1143	136	42	365	795	7.3
				Sept. 8	0840	132	35	351	746	7.0
0158-12-1(43.1)	Elevenmile Creek	Near Darien Center	On Rt. 20, 0.5 mile east of Harlow Rd., 1.8 miles west of Darien Center	a/May 18, 1964	1435	34	9.1	102	239	7.2
				July 27	1256	48	52	184	508	7.5
				Sept. 8	1246	67	74	180	573	8.1
0158-12-1(41.4)	do.	Near Fargo	At bridge on Sumner Rd.	July 2, 1963	1530	63	53	260	621	8.2
0158-12-1(39.9)	Ellicott Creek	Near Crittenden	At bridge on Harlow Rd.	July 2, 1963	1500	37	34	165	399	7.8
0158-12-1(35.3)	do.	At Alden	At bridge on Alden Station Rd.	July 2, 1963	1615	19	53	163	409	7.5
0158-12-1-18(0.4)	Spring Creek	do.	do.	July 2, 1963	1645	38	9.8	240	471	7.5
0158-12-1(28.8)	Ellicott Creek	At Mill Grove	At bridge on Ellicott Rd., at gaging station.	b/July 5, 1963	1125	82	86	261	763	7.5
0158-12-1-16(0.4)	Tributary to Ellicott Creek	do.	At bridge on North Millgrove Rd., 0.3 mile north of Rt. 33.	July 5, 1963	0750	98	155	294	1,010	7.8
				May 6, 1964	1145	36	60	243	624	7.4
				Sept. 12	0935	47	177	230	924	7.2
0158-12-1(14.1)	Ellicott Creek	At Williamsville	At gaging station, at bridge on Wehrle Dr.	a,b/July 2, 1963	1550	353	57	486	1,020	7.9
				July 5	1540	136	56	289	712	8.1

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 19.

Table 19.--Chemical analyses of major streams and tributaries

Remarks.--Sampling point mileage index number precedes the stream name and location followed by U.S. Geological Survey station number (where used) and the point of collection. Additional analyses for some sampling sites are included in tables 17, 18, 20, 21, and are indicated by footnotes in the date of collection column.

(All results in parts per million, except specific conductance, pH, color, and turbidity)

Date of collection	Time (hours)	Instantaneous discharge (cfs)	Percent of time flow exceeded that listed	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids at 180°C	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)	Turbidity
E23(56.7) Cattaraugus Creek at Arcade, at bridge on Rt. 98, 0.1 mile upstream from Clear Creek.																							
Apr. 17, 1963	0900	42	--	1.8	0.03	0.00	42	5.5	3.3	1.0	124	20	7.4	0.1	2.6	156	128	26	259	8.0	6	0.0	0.4
May 7	0800	29	--	1.5	.02	.01	45	7.6	3.0	1.0	143	20	7.8	.1	2.3	166	144	27	288	7.8	5	.0	.4
July 2	1530	14	--	3.2	.01	.03	43	6.9	4.1	1.4	143	17	8.8	.1	1.5	165	136	19	288	8.1	5	.0	.3
E23(54.7) Cattaragus Creek near Arcade, 2134.1 at gaging station, at bridge on North Woods Rd.																							
a/Apr. 17, 1963	1020	102	32	2.8	.01	.01	42	5.6	4.1	1.2	125	18	8.0	.1	5.2	162	128	26	278	7.7	4	.0	.4
May 7	0815	70	42	1.7	.03	.01	44	7.4	3.9	1.1	140	18	8.8	.2	3.4	172	141	26	288	7.9	4	.0	.5
July 2	1605	30	74	2.8	.02	.01	44	6.7	6.0	1.8	145	18	9.7	.1	2.3	170	138	19	295	8.0	4	.1	.0
E23-48(0.6) Elton Creek At The Forks, 2134.2 at water discharge partial-record station, at bridge on Creek Rd.																							
a/Apr. 17, 1963	0950	94	--	3.3	.04	.01	43	5.5	3.2	1.0	127	23	5.5	.1	3.6	157	139	26	272	8.1	6	.0	.6
May 7	0840	72	--	2.3	.05	.01	44	7.2	2.8	.8	140	22	6.0	.3	2.3	162	140	25	282	7.8	3	.0	.3
July 5	1325	35	--	4.2	.03	.00	44	7.0	3.4	1.0	143	25	5.6	.1	1.2	168	139	22	316	7.8	4	.0	.3
E23-33(5.0) Buttermilk Creek near Riceville Station, at bridge on Fox Valley Rd.																							
b/May 18, 1962	--	--	--	2.4	--	--	35	4.1	3.8	1.5	98	25	6.0	.0	.0	128	105	24	226	7.8	3	--	2
E23-33(1.5) Buttermilk Creek near Springville, 2134.50, at gaging station, at bridge on Hayes Hollow Rd.																							
b/May 18, 1962	--	--	--	2.6	--	--	38	5.1	3.0	1.4	110	29	4.0	.0	.0	144	116	26	245	8.0	3	--	2
Oct. 8	1510	--	--	3.8	.04	.03	49	7.3	6.0	1.5	140	47	5.0	.2	.4	199	153	38	334	8.1	3	--	.6
Feb. 4, 1963	1310	--	--	3.9	.01	.03	34	4.0	4.1	.9	93	28	5.8	.1	2.0	135	102	26	233	7.6	2	--	.7
May 7	1555	18	53	2.1	.05	.01	32	4.5	3.2	1.5	95	25	4.0	.2	.1	130	99	21	216	7.8	4	--	.7
E23(26.9) Cattaraugus Creek at Zoar Bridge near Gowanda, 2134.7 at bridge on road to Otto off Zoar Valley Rd.																							
Apr. 17, 1963	1145	c/500	--	3.4	.07	.01	48	6.3	3.8	1.2	136	28	7.7	.2	5.7	180	146	35	302	7.8	5	.0	.8
May 7	0920	307	--	1.6	.03	.01	46	7.9	3.6	1.3	140	29	8.0	.0	2.9	184	148	33	311	7.9	4	.0	.8
July 5	1700	110	--	3.3	.05	.01	51	8.0	5.0	1.6	157	32	10	.1	1.9	206	160	32	339	7.8	4	.0	.3
E23-20(14.4) South Branch Cattaraugus Creek near Otto, 2134.9, at water discharge partial-record station, 0.2 mile upstream from Mansfield Creek.																							
a/Apr. 17, 1963	1220	25	--	2.1	.04	.00	31	2.6	3.2	1.3	80	20	6.1	.1	2.0	114	88	23	194	7.7	5	.0	.3
May 7	1000	19	--	1.2	.05	.00	32	4.9	3.2	1.3	97	20	6.8	.1	1.3	123	100	21	215	7.6	6	.0	.4
July 5	1430	2.8	--	4.1	.03	.01	53	6.3	4.9	1.8	163	27	9.0	.1	.9	201	158	25	336	7.4	3	.0	.6
E23(19.4) Cattaraugus Creek above Gowanda, 2134.98 at southeast side of Gowanda, 0.1 mile downstream from Point Peter Brook.																							
Apr. 17, 1963	1410	--	--	3.6	.87	.02	45	6.0	4.1	1.3	122	29	7.8	.1	4.8	177	137	37	296	7.6	4	.0	.4
May 7	1050	--	--	1.4	.04	.01	45	8.0	3.7	1.2	135	30	7.3	.1	2.5	174	146	35	299	7.9	4	.0	.4
July 5	1030	--	--	4.8	.04	.00	51	7.8	5.0	1.6	159	24	7.4	.0	1.8	201	159	29	339	7.6	3	.0	.5
E23(17.4) Cattaraugus Creek at Gowanda, 2135 at bridge on Rt. 39, at gaging station.																							
a,b,d/Aug. 13, 1956	1730	223	67	6.0	.07	.00	70	8.8	18	1.9	173	54	25	.0	25	307	211	69	503	6.9	5	--	--
Apr. 17, 1963	1600	539	35	3.2	.05	.00	50	6.2	6.3	1.2	134	33	11	.1	7.9	193	151	41	330	7.3	7	.0	.6
May 7	1110	370	48	1.7	.03	.00	52	9.2	16	.8	135	46	25	.1	11	233	168	57	423	6.9	4	.0	.0
July 5	0930	135	84	3.4	.03	.00	57	8.4	24	1.8	162	41	37	.0	6.9	287	177	44	462	7.1	6	.1	.6
E23-6(0.9) Clear Creek near Iroquois, 2140.1 at water discharge partial-record station, at bridge on Rt. 438.																							
Apr. 17, 1963	1630	27	--	3.0	.06	.01	53	8.3	6.4	2.0	128	55	11	.1	2.9	221	166	61	366	7.6	5	.0	.0
May 7	1145	23	--	2.3	.05	.01	51	10	6.4	1.8	134	54	10	.1	.6	205	168	58	362	7.8	3	.0	.0
July 2	1430	3.5	--	5.9	.05	.05	62	12	7.6	2.4	184	54	11	.2	.7	257	204	53	429	7.8	3	.0	.1
E20(2.2) Big Sister Creek at Evans Center, 2140.6 at water discharge partial-record station, at bridge on Rt. 5.																							
a/July 2, 1963	1030	.319	--	23	.23	.00	45	6.8	83	8.6	154	60	99	.3	3.7	422	141	15	675	7.1	40	--	.4
E13(15.3) Eighteenmile Creek at North Boston, 2142 at gaging station, at bridge on Zimmerman Rd.																							
a/May 7, 1963	1235	34	46	2.8	.04	.00	37	7.2	6.8	1.7	91	40	14	.1	2.8	169	122	48	285	7.3	3	.0	.6
July 2	1330	2.96	97	4.9	.05	.00	52	9.4	12	2.6	148	43	19	.1	1.3	228	168	47	387	7.6	4	.0	.0
Apr. 16, 1964	0710	45	38	--	.08	.11	30	6.0	6.1	1.5	74	34	12	--	3.3	144	100	39	240	7.8	3	--	.6
E13-4(2.9) South Branch Eighteenmile Creek at Eden Valley, 2142.3 at water discharge partial-record station, at bridge 300 ft upstream from Rt. 62.																							
a/May 7, 1963	1255	17	--	2.1	.02	.00	33	6.5	4.4	1.6	76	42	9.2	.1	1.7	141	109	47	251	7.5	4	.0	.0
July 2	1115	.40	--	7.8	.03	.01	52	8.6	8.2	2.8	127	55	13	.1	2.1	222	165	61	379	7.7	7	.0	.0
E13(0.5) Eighteenmile Creek at Highland-On-the-Lake, 2142.4 at water discharge partial-record station, at bridge on Lake Shore Rd.																							
May 7, 1963	1350	58	--	1.2	.07	.00	41	8.9	12	1.8	95	55	22	.1	2.7	196	139	61	350	8.2	6	.1	.0
July 2	0840	3.2	--	8.7	.06	.01	68	11	41	5.0	148	70	80	.4	1.0	374	215	93	629	7.3	7	.4	.0

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 18.
c/ Estimated.
d/ Additional analyses in table 19.

Table 19.--Chemical analyses of major streams and tributaries (Continued)

Date of collection	Time (hours)	Instantaneous discharge (cfs)	Percent of time flow exceeded that listed	Silica (SiO2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO3)	Sulfate (SO4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO3)	Dissolved solids at 180°C	Hardness as CaCO3: Calcium, magnesium	Hardness as CaCO3: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)	Turbidity
E1-55(0.1) Beaver Meadow Creek at Java Village, at bridge on Rt. 78.																							
b/Aug. 29, 1962	1355	--	--	4.3	0.12	0.02	47	12	3.6	1.4	176	23	6.2	0.2	0.8	193	167	23	334	7.2	5	--	0.9
E1(40.9) Buffalo Creek at Java Village, 2143.7 at bridge on Whitney Rd.																							
May 8, 1963	0715	22	--	1.9	.07	.01	50	11	4.2	1.0	168	30	6.8	.1	1.9	194	170	33	346	8.0	4	0.0	.0
July 5	1215	7.1	--	5.0	.06	.01	53	11	4.5	1.4	180	33	6.0	.1	4.6	212	177	30	356	7.8	7	.0	.4
E1(31.8) Buffalo Creek near Wales Hollow, 2144 at gaging station, at bridge on Marlou Rd.																							
a/May 8, 1963	0740	30	57	1.5	.19	.00	50	11	4.6	1.5	160	36	8.0	.1	1.9	200	170	39	358	8.1	4	.0	.0
July 2	1240	7.0	92	5.0	.05	.00	58	11	6.2	2.8	175	41	10	.1	1.2	226	190	46	393	7.4	6	.0	.5
E1-30(0.3) Hunter Creek at Wales Center, at bridge on Rt. 78.																							
Aug. 29, 1962	1315	--	--	3.7	.03	.03	68	13	9.2	2.7	156	94	15	.1	.5	300	223	95	471	7.9	3	--	.4
E1(29.5) Buffalo Creek at Wales Center, at bridge on Rt. 20A.																							
Apr. 10, 1961	1810	--	--	3.1	.15	--	25	4.0	2.9	1.4	58	28	5.5	.1	2.2	112	79	32	184	7.3	14	--	--
Aug. 21	1000	--	--	2.9	.14	.0	53	12	4.7	2.0	176	41	5.4	.0	.4	224	182	38	384	7.6	4	--	--
E1(27.1) Buffalo Creek at Porterville, at bridge on Porterville Rd.																							
Aug. 29, 1962	1305	--	--	3.9	.20	.00	45	20	6.7	2.5	177	46	11	.2	.5	233	195	50	407	7.2	2	--	.0
E1(18.0) Buffalo Creek at Elma, 2144.7 at bridge on Bowen Rd.																							
b/Apr. 10, 1961	1845	--	--	3.1	.21	.0	27	4.3	3.1	1.4	62	30	6.5	.0	2.0	118	85	34	194	7.2	14	--	--
Aug. 21	1030	--	--	2.5	.04	.0	55	12	4.8	2.0	180	42	5.8	.0	.3	231	187	39	394	7.9	4	--	--
May 8, 1963	0815	58	--	.8	.05	.00	51	14	5.4	1.6	162	44	10	.1	1.7	216	185	52	380	7.7	4	.0	.0
July 5	1320	26	--	4.4	.07	.01	55	8.6	6.5	2.9	145	53	12	.2	2.6	227	173	54	378	7.5	9	.0	.8
E1(10.4) Buffalo Creek at Gardenville, 2145 at bridge on Union Rd, 700 ft upstream from gaging station.																							
a,e/June 20, 1951	--	c/27	74	1.0	.19	--	52	11	3.7	1.6	155	47	5.0	.1	1.4	218	175	48	339	7.7	20	--	--
Aug. 13, 1956	1530	36	66	4.9	.24	.8	47	11	5.0	2.6	147	42	10	.4	.4	210	162	42	347	8.0	9	--	--
Apr. 10, 1961	1900	f/954	4	3.1	.11	.0	29	4.6	3.7	1.5	67	33	6.3	.3	2.6	131	92	37	210	7.3	8	--	--
Aug. 21	1200	32	71	.9	.04	.0	52	12	5.7	2.1	165	44	7.6	.0	.7	223	179	44	378	7.8	9	--	--
May 8, 1963	0900	118	34	.3	.04	.01	50	14	3.9	.9	160	37	13	.1	1.5	204	183	52	383	7.6	5	.0	.0
July 5	1030	21.3	91	3.9	.05	.01	51	8.7	6.5	3.1	136	55	12	.1	2.5	218	163	52	359	7.4	8	--	.2
Apr. 16, 1964	0810	122	32	--	.14	.07	47	9.1	6.0	1.6	g/133	38	11	--	--	212	155	42	334	8.3	1	--	.6
E1-6(23.3) Cayuga Creek at Cowlesville, at bridge on Urf Rd.																							
May 8, 1963	0930	16	--	1.4	.04	.00	43	8.6	4.4	1.8	128	36	7.5	.1	.8	170	143	38	302	7.9	4	.0	.0
July 5	1415	1.9	--	3.8	.03	.01	58	11	11	2.7	162	48	24	.1	.2	258	190	57	423	7.8	4	.0	.6
E1-6(11.0) Cayuga Creek near Lancaster, 2150 at bridge on Bowen Rd., 700 ft upstream from gaging station.																							
June 20, 1951	--	16	66	1.7	.33	--	54	10	4.5	3.6	159	45	8.0	.1	.8	222	176	46	352	8.0	15	--	--
Aug. 13, 1956	1440	57	40	4.4	.14	.00	43	7.2	3.3	2.6	119	38	7.7	.0	.2	175	137	39	287	7.1	8	--	--
May 8, 1963	1025	28	55	.1	.03	.01	48	13	6.2	2.0	149	43	14	.1	1.4	205	174	52	370	8.1	3	.0	.0
July 5	1420	6.0	81	3.9	.07	.01	54	8.2	6.5	3.1	141	52	13	.1	1.7	227	168	53	375	7.6	9	.0	.3
Apr. 16, 1964	0845	66	37	--	.07	.00	45	7.4	6.0	1.8	121	39	11	--	--	189	143	44	317	8.0	5	--	.2
E1-4-15(0.5) West Branch Cazenovia Creek near East Aurora, 2152.5 at water discharge partial-record station, at bridge on Jewett-Holmwood Rd.																							
May 8, 1963	1130	42	--	.7	.03	.00	36	6.6	6.1	1.5	92	39	12	.1	.4	153	117	42	267	7.6	2	.0	.0
July 5	1110	4.9	--	3.8	.16	.02	49	9.1	8.7	2.2	124	60	14	.1	.3	214	160	59	352	7.6	5	.0	.6
Apr. 15, 1964	1815	--	--	--	.05	.03	28	5.0	5.1	1.2	70	30	9.1	--	--	129	90	33	213	8.0	6	--	.6
E1-4-14(8.1) East Branch Cazenovia Creek at South Wales, 2153.5 at water discharge partial-record station at bridge on Darling Rd.																							
a/May 8, 1963	1100	29	--	1.9	.05	.00	36	7.5	6.0	1.3	100	34	11	.1	1.2	154	121	39	273	7.8	2	.0	.0
July 2	0730	5.3	--	6.3	.03	.00	45	8.0	7.1	1.8	131	38	12	.0	2.0	199	146	38	330	7.3	6	.0	.4
Apr. 15, 1964	1835	83	--	--	.08	.16	27	5.6	5.4	1.2	72	28	9.1	--	--	127	90	32	214	8.1	6	--	.3
E1-4(4.1) Cazenovia Creek at Ebenezer, 2155 at gaging station, at bridge on Ridge Rd.																							
a,b/June 20, 1951	--	24	76	2.6	.07	--	42	10	15	2.0	104	51	28	.2	.8	234	146	60	362	7.3	15	--	--
Aug. 13, 1956	1545	31	71	3.6	.15	.00	51	11	13	3.1	135	58	20	.1	1.3	235	173	62	395	8.2	4	--	--
May 8, 1963	1255	81	46	.3	.11	.00	46	9.2	19	2.0	120	47	32	.1	1.0	220	153	55	398	8.0	5	.0	.1
July 2	1515	10	92	3.9	.06	.02	58	11	28	3.5	h/111	69	48	.1	.8	296	190	72	491	8.8	7	.1	.7
Apr. 16, 1964	0745	158	30	--	.12	.07	36	6.4	12	1.4	88	36	20	--	--	181	116	44	293	7.9	6	--	.6

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 18.
c/ Estimated.
e/ Additional analyses in table 21.
f/ Daily mean.
g/ Sample also contained 2 ppm carbonate (CO_3).
h/ Sample also contained 16 ppm carbonate (CO_3).

Table 19.--Chemical analyses of major streams and tributaries (Continued)

Date of collection	Time (hours)	Instantaneous discharge (cfs)	Percent of time flow exceeded that listed	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids at 180°C	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)	Turbidity
0158-12(100.6) Tonawanda Creek near Johnsonburg, 2164, at water discharge partial-record station, at bridge on Rt. 98.																							
a/May 8, 1963	1400	17.4	49	2.2	0.06	0.01	32	18	2.9	1.0	150	26	5.1	0.1	1.5	170	154	31	302	8.2	4	0.0	0.0
July 2	1310	7.0	85	5.2	.03	.01	47	13	3.7	1.4	174	27	5.8	.1	.6	198	171	29	338	8.1	6	.0	.0
Apr. 15, 1964	1735	154	6	--	.10	.10	35	7.2	2.6	.9	112	22	4.0	--	--	150	117	25	237	8.1	5	--	.7
0158-12(85.6) Tonawanda Creek near Attica, 2164.6 at bridge on Stroh Rd.																							
May 8, 1963	1430	50	--	2.2	.09	.02	56	12	5.6	1.7	178	37	12	.1	1.8	220	189	43	385	8.2	2	.0	.1
July 2	1450	14	--	5.6	.11	.00	61	11	7.2	2.8	188	40	10	.1	8.2	253	197	43	411	7.3	5	.1	.6
0158-12-32(9.4) Little Tonawanda Creek at Linden, 2165 at gaging station at bridge in Linden.																							
a/May 8, 1963	1455	9.9	47	3.1	.14	.00	52	10	4.2	1.3	172	28	6.8	.1	1.2	196	171	30	348	8.1	4	.0	.0
July 2	1100	1.84	76	6.5	.11	.00	59	13	4.9	1.4	207	33	6.4	.1	.2	234	201	31	420	7.9	6	.0	.4
0158-12(69.2) Tonawanda Creek at Batavia, 2170 at gaging station, 500 ft upstream from bridge on Walnut St.																							
a/Aug. 13, 1956	1310	86	47	6.5	.21	.00	61	13	5.0	2.6	206	34	9.9	.2	1.9	244	206	37	410	7.4	12	--	--
May 8, 1963	1530	73	51	2.3	.19	.01	62	12	6.6	1.7	193	38	13	.0	1.4	238	204	46	416	7.9	4	.0	.0
July 2	0740	21	82	4.2	.05	.06	57	11	6.8	3.5	180	41	12	.1	2.6	236	187	40	404	7.5	8	.1	.7
Apr. 16, 1964	1355	179	30	--	.23	.31	50	9.9	6.3	1.7	150	35	12	--	--	211	166	42	349	8.0	6	--	.8
0158-12(54.1) Tonawanda Creek at Indian Falls, 2174 at bridge on Rt. 77.																							
May 8, 1963	1620	86	--	1.2	.13	.01	68	13	12	1.7	205	41	24	.2	3.5	276	223	55	473	7.5	6	.1	.4
July 2	--	27	--	5.9	.04	.23	69	16	23	3.8	229	43	37	.2	4.0	319	238	51	560	7.6	8	.3	.1
Apr. 16, 1964	1220	257	--	--	.16	.17	54	11	8.8	1.7	155	40	19	--	--	249	180	52	388	7.8	6	--	.6
0158-12(46.9) Tonawanda Creek near Alabama, 2175 at gaging station, at bridge on Meadville Rd.																							
a/May 8, 1963	1650	35	50	1.9	.10	.01	80	14	16	1.7	205	73	31	.2	2.5	333	257	89	562	8.1	6	.1	.4
July 2	1015	34.7	76	6.8	.05	.08	85	17	29	3.5	232	84	46	.2	3.0	410	282	92	670	7.6	12	.2	.2
Apr. 16, 1964	1205	261	28	--	.13	.14	58	12	11	1.8	162	56	20	--	--	275	194	61	439	8.0	6	--	.7
9158-12-11-1(13.0) Murder Creek at Pembroke, 2177, at water discharge partial-record station, at bridge on Lake Rd.																							
May 8, 1963	1600	12	--	1.5	.14	.03	80	13	12	1.7	233	46	25	.3	.8	308	253	62	520	7.5	34	.0	.8
July 2	1330	0	--	5.0	.10	.12	84	22	30	3.8	289	29	71	.3	2.1	414	300	63	697	7.4	22	.0	.7
Apr 16, 1964	1320	46	--	--	.10	.01	69	12	9.0	2.0	185	54	20	--	--	292	222	70	454	7.7	26	--	1
0158-12(19.5) Tonawanda Creek at Rapids, 2180 at gaging station, at bridge at Rapids.																							
a/May 8, 1963	1730	165	44	1.5	.15	.01	102	16	12	1.7	219	134	31	.2	1.8	437	321	141	675	7.4	7	.0	.4
July 2	0930	48	74	2.5	.09	.00	146	22	29	2.8	247	240	48	.3	.6	650	455	253	950	7.4	8	.1	.5
Apr. 16, 1964	1030	459	24	--	.18	.17	76	14	12	2.0	169	92	16	--	--	339	247	108	521	7.6	15	--	.3
0158-12(14.1) Tonawanda Creek at Millersport, at bridge on Rts. 78 and 263.																							
June 20, 1951	--	c/50	--	4.2	.33	--	88	15	8.3	2.4	202	109	12	.4	1.1	366	281	116	557	7.5	25	--	--
0158-12-6(2.5) Ransom Creek near Swormville, at bridge on Rt. 263.																							
b/May 8, 1963	1800	19	--	2.4	.19	.02	205	29	16	2.1	202	422	33	.4	.6	818	632	466	1,160	7.2	5	.0	.4
July 2	1155	1.6	--	3.5	.13	.04	477	67	52	5.3	148	1,200	107	.7	1.2	2,260	1,470	1,350	2,360	7.2	6	.1	.6
Apr. 16, 1964	1110	44	--	--	.15	.13	120	20	12	2.1	185	212	26	--	--	531	382	230	754	7.9	10	--	.2
0158-12-3(1.4) Bull Creek at Hoffman, at bridge on Town Line Rd., 1 mile south of Killean Rd.																							
a,b/Apr. 10, 1961	2005	--	--	4.1	.14	.1	39	14	11	3.4	71	89	20	.2	6.3	241	155	97	370	6.8	79	--	--
Aug. 21	1345	--	--	8.8	.06	.0	64	22	23	3.8	200	77	38	.4	1.7	354	250	86	564	8.1	23	--	--
0158-12-1(28.8) Ellicott Creek at Mill Grove, 2184.5 at bridge on Ellicott Rd., at gaging station.																							
a/May 8, 1963	1840	8.6	53	1.0	.13	.03	74	11	17	2.1	204	49	32	.3	1.1	302	230	63	507	7.7	9	.1	.4
July 5	1125	2.0	74	7.1	.06	.03	80	15	59	5.1	224	82	86	.4	.6	472	261	78	763	7.5	14	.7	.4
Apr. 16, 1964	0905	24	35	--	.34	.07	59	9.6	12	2.2	159	50	20	--	--	255	187	56	419	7.6	11	--	.1
0158-12-1(14.1) Ellicott Creek at Williamsville, 2185 at gaging station at bridge on Wehrle Dr.																							
a,b/May 8, 1963	1915	24	54	1.0	.14	.02	86	14	22	2.8	196	103	42	.3	1.0	384	272	112	626	7.7	8	.1	.6
July 2	1550	.88	92	5.5	.03	.02	165	18	27	3.1	113	353	57	.4	.7	717	486	393	1,020	7.9	8	.1	.4
Apr. 16, 1964	1005	77	30	--	.16	.07	122	15	18	2.7	212	193	30	--	--	531	366	192	765	7.9	6	--	.4
E240(0.0) Erie (Barge) Canal, at Pendleton, at bridge on Tonawanda Creek Rd.																							
Dec. 6, 1960	1130	--	--	1.5	.27	.0	58	11	21	2.1	124	75	40	.2	3.9	290	190	88	484	7.0	1	--	--

a/ Additional analyses included in table 17.
b/ Additional analyses included in table 18.
c/ Estimated.

Table 20.--Chemical analyses of Cattaraugus Creek at Gowanda, October 1958 to September 1959

Sampling point mileage index number.--E23(17.4).
U.S. Geological Survey station number.--2135.
Point of collection.--At bridge on Rt. 39, at gaging station.
Remarks.--Additional analyses included in tables 17, 18, and 19.

Chemical analyses, in parts per million

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)		Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed: Unfiltered	Oxygen consumed: Filtered
Oct. 1-6, 1958..	410	6.8	0.26	51	9.2	12		0.6	146	42	16	0.4	8.8	237	165	46	393	7.2	5	--	2
Oct. 7..........	252	--	.16	--	--	--		--	326	--	142	--	1.2	--	252	0	952	6.5	--	--	--
Oct. 8-20.......	288	6.1	.10	52	10	16		.6	151	47	23	.2	4.2	251	171	47	419	6.8	5	--	2
Oct. 21-31......	301	5.9	.18	52	10	17		.6	144	54	22	.1	5.8	253	171	53	426	6.7	5	--	2
Nov. 1-10.......	271	6.6	.12	53	9.3	14		1.3	150	48	18	.1	5.4	242	170	47	407	7.0	5	--	--
Nov. 11-14......	622	--	.20	--	--		13a/		142	50	17	--	5.8	--	168	52	384	7.1	3	--	--
Nov. 15-20......	1,441	7.3	.31	40	5.8	4.4		1.7	111	30	6.5	.1	2.3	169	124	33	262	7.1	5	--	--
Nov. 21-30......	681	7.2	.16	42	6.8	7.7		1.1	116	36	10	.0	4.1	180	133	38	297	7.0	3	--	--
Dec. 1-20.......	726	7.0	.07	41	7.5	8.5		1.1	117	40	11	.0	3.4	183	134	38	292	7.2	5	--	--
Dec. 21-31......	505	8.8	.04	46	8.2	12		1.1	131	40	15	.1	5.8	212	149	41	338	7.2	3	--	--
Jan. 1-5, 1959..	574	--	.04	--	--		9.9a/		126	32	10	--	1.7	--	131	28	288	7.2	3	--	--
Jan. 6..........	450	--	.23	--	--		16a/		123	64	29	--	12	--	183	82	474	6.8	--	--	--
Jan. 7-20.......	547	7.5	.06	43	7.9	13		1.2	120	40	16	.0	6.3	209	140	42	332	7.0	4	5	1
Jan. 21-31......	3,534	13	.08	36	5.8	5.4		1.7	107	29	7.0	.1	2.5	166	114	27	255	7.5	4	2	1
Feb. 1..........	1,570	--	.59	--	--		2.8a/		75	18	5.6	--	3.7	--	85	24	166	7.9	--	--	--
Feb. 2-19.......	1,521	7.2	.15	38	6.4	5.9		1.4	104	29	9.0	.0	5.8	165	122	37	255	7.4	5	--	--
Feb. 20-28......	647	7.0	.20	46	7.6	9.6		1.3	132	38	14	.1	5.3	211	147	39	327	7.1	5	--	--
Mar. 1-6........	1,089	7.5	.47	46	7.2	9.6		1.4	126	40	15	.1	6.4	211	145	41	328	7.2	4	--	--
Mar. 7-8........	1,660	--	.28	--	--		3.4a/		92	22	5.1	--	3.7	--	101	26	203	7.5	--	--	--
Mar. 9-10.......	884	--	.07	--	--		12a/		116	49	17	--	4.7	--	147	52	331	6.9	--	--	--
Mar. 11-20......	1,363	9.7	.22	42	6.9	8.7		1.4	116	35	12	.0	5.9	190	134	39	294	7.1	3	--	--
Mar. 21-31......	2,522	9.1	.35	34	5.2	3.8		1.4	97	24	5.1	.1	4.4	145	107	27	216	7.6	3	--	--
Apr. 1-10.......	3,951	10	.30	34	5.1	3.5		1.5	102	22	4.0	.3	2.5	178	106	23	223	7.4	5	7	1
Apr. 11-20......	916	6.1	.08	40	7.1	6.2		1.5	118	28	10	.2	4.4	194	129	33	283	7.4	5	4	1
Apr. 21-30......	649	5.1	.06	44	8.3	9.2		1.5	128	37	14	.2	4.6	222	144	39	332	7.1	5	7	1
May 1-31........	440	5.7	.10	51	8.5	12		1.7	140	40	18	.1	5.3	227	162	48	366	7.2	5	--	--
June 1-25.......	226	6.5	.16	59	9.9	18		2.0	154	57	26	.1	5.5	286	188	62	476	7.0	4	--	--
June 26-30......	301	--	.50	--	--		11a/		151	37	16	--	4.3	--	164	41	370	7.3	--	--	--
July 1-12.......	181	9.0	.04	64	10	18		1.9	195	44	24	.1	2.4	278	201	41	483	6.9	5	--	--
July 13.........	123	--	.79	--	--		54a/		376	64	24	--	.0	--	292	0	708	7.1	--	--	--
July 14-18......	117	--	.19	--	--		24a/		183	80	28	--	3.9	--	223	73	532	6.9	--	--	--
July 19-23......	127	23	.14	45	15	11		1.9	169	38	12	.1	3.1	242	174	36	382	7.3	12	--	--
July 24-26......	122	--	.06	--	--		9.0a/		178	65	16	--	1.7	--	218	72	461	6.9	--	--	--
July 27-31......	107	--	.29	--	--		29a/		236	62	29	--	.1	--	236	43	567	7.0	--	--	--
Aug. 1-3........	95	--	.23	--	--		30a/		218	52	15	--	.5	--	189	11	488	7.0	--	--	--
Aug. 4-9........	106	--	.12	--	--		44a/		293	64	37	--	.6	--	263	23	732	6.9	--	--	--
Aug. 10-21......	95	8.0	.25	62	12	23		2.2	157	73	33	.1	.9	318	204	76	573	6.8	12	--	--
Aug. 22-24......	118	--	.31	--	--		21a/		110	68	29	--	6.4	--	161	71	400	6.3	--	--	--
Aug. 25.........	92	--	.14	--	--		83a/		248	108	84	--	1.3	--	256	53	801	6.7	--	--	--
Aug. 26-31......	261	6.4	.14	41	24	12		2.3	151	72	17	.1	4.1	260	201	78	444	6.8	10	--	--
Sept. 1-7.......	142	12	.12	58	12	12		2.2	160	51	18	.1	10	264	194	63	436	7.1	6	--	--
Sept. 8-17......	82	6.8	.38	85	13	23		2.3	279	52	27	.1	.0	354	266	37	682	6.9	17	--	--
Sept. 18-21.....	86	--	.11	--	--		9.0a/		202	39	9.6	--	4.9	--	204	39	429	7.0	--	--	--
Sept. 22........	85	--	.25	--	--		66a/		384	83	18	--	.0	--	284	0	810	7.0	--	--	--
Sept. 23-28.....	88	6.0	.21	62	12	14		1.9	172	51	18	.1	15	266	204	63	481	7.0	10	--	--
Sept. 29-30.....	105	--	.40	--	--		51a/		192	94	58	--	23	22	244	87	713	7.4	--	--	--
Time-weighted average.........	755	7.7	0.03	49	8.9	12		1.5	147	44	18	0.1	4.6	226	164	44	384	--	5	--	--
Maximum observed..............		23	0.79	85	24	23	83a/	2.3	384	108	142	0.4	23	354	292	87	952	7.9	17	--	--
Minimum observed..............		5.1	.04	34	5.1	3.5	2.8a/	.6	75	18	4.0	.0	.0	145	85	0	166	6.3	3	--	--

a/ Sodium plus potassium as sodium.

Table 21.--Chemical analyses of Buffalo Creek at Gardenville, October 1961 to September 1962

Sampling point mileage index number.--E1(10.4).
U.S. Geological Survey station number.--2145.
Point of collection.--At bridge on Union Rd., 700 ft upstream from gaging station.
Remarks.--Additional analyses included in tables 17, 18, and 19.

Chemical analyses, in parts per million

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)		Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed: Unfiltered	Oxygen consumed: Filtered
Oct. 1-31, 1961	24.8	7.4	0.05	50	15	6.9		2.4	168	53	10	0.7	1.0	238	187	49	392	7.1	4	3	3
Nov. 1-30......	82.9	8.0	.05	59	12	6.8		2.6	182	47	11	.0	1.3	249	197	48	405	7.6	9	6	3
Dec. 1-10......	144	8.9	.10	54	10	6.4		2.3	148	50	12	.3	1.9	231	176	71	373	7.7	4	4	4
Dec. 11-14.....	334	--	.14	--	--		7.4 a/		101	36	9.0	--	2.3	--	119	36	273	7.5	5	--	--
Dec. 15-31.....	146	11	.10	51	11	9.6		2.2	146	48	16	.3	4.4	234	172	53	399	7.4	4	--	--
Jan. 1-2, 1962.	51.0	--	.36	--	--		14 a/		183	66	22	--	7.7	--	224	74	492	7.4	--	--	--
Jan. 3-5.......	63.3	--	.20	--	--		36 a/		180	57	62	--	13	--	226	79	639	7.3	--	--	--
Jan. 6.........	120	--	.25	--	--	--		--	155	45	18	--	--	--	194	67	427	7.3	--	--	--
Jan. 7.........	1,100	--	2.9	--	--	--		--	82	23	12	--	--	--	100	33	242	7.2	--	--	--
Jan. 8.........	383	--	.64	--	--	--		--	180	76	48	--	--	--	253	105	628	7.8	--	--	--
Jan. 9-26......	164	10	.47	51	9.4	9.4		2.3	132	49	16	.0	4.3	246	166	58	374	7.8	6	5	4
Jan. 27-30.....	631	--	.54	--	--		5.3 a/		108	40	11	--	3.7	--	137	49	299	7.6	--	--	--
Jan. 31........	100	--	.41	--	--		12 a/		158	57	36	--	7.0	--	220	91	536	6.8	--	--	--
Feb. 1-3.......	85.3	--	.26	--	--		14 a/		164	62	21	--	8.0	--	204	70	454	8.1	--	--	--
Feb. 4.........	160	--	.85	--	--		249 a/		152	54	412	--	12	--	228	104	1,580	6.9	--	--	--
Feb. 5-8.......	449	--	.53	--	--		.7 a/		110	28	13	--	2.3	--	138	48	293	7.6	--	--	--
Feb. 9-24......	82.2	8.8	.14	59	11	12		2.1	164	52	19	.0	6.3	267	192	58	435	7.6	6	4	3
Feb. 25-28.....	768	--	.54	--	--		5.1 a/		100	26	15	--	2.4	--	121	39	272	7.9	--	--	--
Mar. 1-9.......	180	13	.16	50	9.3	8.8		2.3	144	42	13	.1	3.6	225	164	46	353	7.6	4	--	--
Mar. 10-31.....	517	8.2	.47	40	6.7	6.8		2.0	108	35	13	.1	4.0	186	128	39	295	7.3	12	10	3
Apr. 1-30......	310	5.5	.30	46	6.4	5.8		1.9	114	29	21	.1	1.9	186	142	48	295	7.2	14	10	3
May 1-31.......	88.3	5.4	.09	49	11	7.1		2.0	152	45	5.0	.1	.9	213	168	43	355	7.5	5	4	3
June 1-30......	28.8	7.3	.14	46	13	7.7		2.3	148	51	10	.1	1.2	220	169	47	361	7.5	3	5	3
July 1-31......	9.49	7.2	.14	41	13	9.2		2.6	126	54	12	.1	1.2	215	156	53	356	7.4	3	4	3
Aug. 1-31......	11.0	8.0	.05	40	13	8.8		2.5	124	56	12	.1	1.2	216	154	52	355	7.4	3	5	3
Sept. 1-30......	24.5	8.9	.09	46	13	8.9		2.6	136	60	12	.1	1.4	230	169	57	372	7.6	3	3	3
Time-weighted average.....	137	7.9	0.18	48	11	8.8		2.3	141	48	14	0.2	2.3	223	166	51	368	--	6	5	3
Maximum observed...........		13	2.9	59	15	9.6	249 a/	2.6	183	76	412	0.7	13	267	253	105	1,580	8.1	14	10	4
Minimum observed...........		5.4	.05	40	6.4	5.8	.7	1.9	82	23	5.0	.0	.9	186	100	33	242	6.9	3	3	3

a/ Sodium plus potassium as sodium.

Table 22.--Chemical analyses of the Niagara River at Niagara Falls, October 1958 to September 1959

Sampling point mileage index number.--0158(19.6).
U.S. Geological Survey station number.--2160.
Point of collection.--At water intake for city of Niagara Falls, in west channel near Navy Island, approximately 1.6 miles offshore from Niagara Falls.

Chemical analyses, in parts per million

Date of collection	Mean discharge (thousands cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed: Unfiltered	Oxygen consumed: Filtered
October 7-15, 18-20, 1958..	175	6.6	0.08	40	9.0	9.7	0.5	125	23	22	0.2	0.0	188	137	35	311	7.3	3	--	2
Oct. 21-31................	169	8.5	.07	38	8.0	10	.5	123	22	21	.2	.0	187	128	27	309	7.4	3	--	2
Nov. 1-5,11,13-17,20.......	167	7.3	.06	41	8.2	9.0	1.0	125	24	22	.3	.0	185	136	34	312	7.3	5	--	--
Nov. 21-25, 27-29..........	178	4.7	.07	41	8.0	8.6	1.0	122	24	22	.2	.0	179	136	36	308	7.7	5	--	--
Dec. 8, 9, 18, 20..........	163	4.3	.08	40	7.8	11	1.2	119	26	25	.1	.3	187	132	35	316	7.4	3	--	--
Dec. 21-23, 26-31..........	159	4.3	.03	38	9.4	10	1.2	121	27	22	.2	.2	186	134	35	306	7.7	3	--	--
Jan.6-10,12-14,18,20,1959..	153	5.4	.03	39	8.3	11	1.3	125	22	23	.4	.2	197	132	29	311	7.6	5	1	1
Jan. 21-31................	167	5.1	.04	39	8.2	11	1.2	122	24	20	.4	.3	195	131	31	308	7.7	6	1	1
Feb. 1-20..................	164	3.8	.07	39	9.6	11	1.1	123	25	22	.3	5.2	181	137	36	305	7.6	3	--	--
Feb. 21-28.................	169	5.6	.06	40	9.5	9.8	1.1	124	25	22	.3	5.8	186	139	38	305	7.8	2	--	--
Mar. 1-12,14-15,17-20......	176	6.8	.03	41	8.3	10	1.3	126	21	23	.1	.6	203	137	33	303	7.8	2	--	--
Mar. 22-31.................	175	4.7	.03	41	8.3	9.3	1.3	122	24	22	.1	1.2	194	137	37	303	7.6	2	--	--
Apr. 1-30..................	186	4.6	.03	37	7.5	9.0	1.3	110	24	20	.1	1.4	191	124	34	295	7.8	3	5	2
May 1-5, 7-27..............	196	5.1	.05	37	8.0	9.2	1.3	113	22	22	.1	.2	187	126	33	293	7.7	5	--	--
June 4-30..................	196	6.4	.02	39	8.1	11	1.5	120	23	25	.1	.4	192	131	33	310	7.7	2	--	--
July 1-7, 9-31.............	188	7.7	.01	40	8.0	11	1.3	120	25	24	.1	.2	195	133	35	315	7.5	2	--	--
Aug. 1-11, 13-31...........	182	--	.02	--	--	5.8a/		122	23	23	--	.1	--	144	44	315	7.5	3	--	--
Sept. 1-22, 24-27..........	176	9.5	.02	39	8.7	12	1.5	122	26	23	.2	.8	182	134	34	318	7.6	5	--	--
Time-weighted average	179	6.2	0.04	39	8.3	10	1.2	120	24	22	0.2	0.9	190	133	35	308	--	3	--	--

a/ Sodium plus potassium as sodium

Table 23.--Chemical analyses of the Erie (Barge) Canal at Lockport

Sampling point mileage index number.--E230(0.8).
U.S. Geological Survey station number.--2196.
Point of collection.--at Lock 35.

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed: Unfiltered	Oxygen consumed: Filtered
Chemical analyses in parts per million, water year October 1958 to September 1959																				
Oct. 6, 1958......	354	1.2	0.14	42	9.1	12	1.8	121	39	23	0.3	1.3	200	143	44	339	7.1	3	--	--
Nov. 6............	353	.8	.19	48	9.7	12	1.6	126	40	26	.1	2.8	214	160	57	371	6.9	5	--	--
Dec. 4............	353	2.4	.42	58	11	14	2.2	131	66	29	.2	4.1	267	190	82	432	6.7	3	--	--
Jan. 5, 1959......	17	6.0	.09	91	16	14	2.1	198	121	24	.1	4.1	393	293	131	601	7.2	5	--	--
Feb. 9............	5.2	5.9	.21	66	13	14	2.9	142	87	29	.2	7.1	318	218	102	494	7.0	5	--	--
Mar. 4............	43	2.0	.53	60	13	100	4.5	141	42	185	.3	6.2	531	203	88	917	6.6	5	--	--
Apr. 6............	51	4.8	.17	48	13	7.3	3.0	118	58	18	.3	4.4	276	174	77	375	7.0	25	--	--
May 5.............	98	2.0	.05	56	12	12	1.8	130	68	24	.0	2.4	264	189	83	424	6.9	6	--	--
June 1............	260	1.1	.10	48	9.6	12	2.1	125	47	26	.0	2.6	231	160	57	378	7.0	6	--	--
July 9............	409	1.5	.10	48	9.6	13	1.8	120	50	26	.3	3.3	224	160	61	371	6.8	3	--	--
Aug. 3............	415	1.4	.14	41	7.9	12	1.7	118	34	22	.2	2.8	195	135	39	338	7.3	3	--	--
Sept.14...........	394	1.4	.36	45	8.1	13	1.8	119	44	25	.1	2.2	207	146	49	363	7.2	3	--	--
Chemical analyses, in parts per million, water year October 1961 to September 1962																				
Oct. 1-4,6-14,1961..	--	1.7	0.07	50	11	14	2.1	126	48	32	0.1	2.9	241	170	67	409	7.1	3	5	3
Oct. 15-17.........	--	--	.08	--	--	a/11		125	41	28	--	1.1	--	161	59	368	7.1	2	--	--
Oct. 18-31.........	--	4.1	.07	50	10	14	2.0	126	51	29	.2	3.1	236	166	63	397	7.2	2	--	--
Nov. 1-18..........	--	11	.12	52	10	16	2.1	134	51	28	.0	3.1	245	171	61	416	7.1	3	6	2
Nov. 19-30.........	--	7.3	.14	60	12	15	2.6	132	77	30	.1	3.7	286	199	91	467	7.0	3	--	--
Dec. 1-8...........	--	7.7	.15	56	12	15	2.2	136	66	30	.3	3.1	277	189	78	449	7.1	1	--	--
Dec.9,11-24,26-31...	--	10	.12	78	19	18	3.0	180	116	32	.3	3.9	409	273	125	626	7.2	2	10	5
Jan.1-6,8-13,1962...	--	14	.28	102	20	22	3.0	191	167	38	.1	1.4	518	337	181	736	7.6	9	--	--
Jan.15-20,22,24-31..	--	7.4	.54	77	16	20	3.3	154	124	38	.2	5.4	410	258	132	616	7.5	14	--	--
Feb. 1-3,5..........	--	--	.61	--	--	a/20		137	95	35	--	6.1	--	223	111	533	7.2	--	--	--
Feb.6-10,12-14......	--	6.5	.66	62	14	15	3.2	130	95	28	.2	5.7	328	212	106	497	7.4	16	--	--
Feb. 15-17, 19-21,.. 23-24, 26-28.......	--	6.8	.33	91	16	23	2.8	182	145	36	.2	5.3	454	293	144	682	7.5	14	18	5
Mar. 1-11...........	--	7.3	.22	67	15	20	3.0	142	100	35	.0	5.1	347	229	112	551	6.7	14	--	--
Mar. 12-16..........	--	--	.29	--	--	a/8.3		80	40	16	--	4.4	--	115	50	280	7.4	19	--	--
Mar. 17,19-23, 26-31............	--	6.5	.28	52	13	10	2.6	123	77	18	.0	2.8	259	183	82	413	6.9	19	10	6
Apr. 2-14, 16-21, 23-28,30.........	--	7.3	1.1	59	13	11	2.1	144	62	24	.2	2.9	293	201	83	438	7.5	22	10	4
May 1-12,14-31......	--	5.4	.17	60	11	13	2.0	142	68	25	.2	2.6	270	195	78	446	7.2	4	8	4
June 1-30...........	--	6.9	.16	54	10	15	2.2	132	64	26	.2	3.2	266	176	68	430	7.1	4	10	3
July 2-7, 9-21, 23-31............	--	5.1	.10	48	9.6	15	1.9	126	52	24	.2	2.7	242	160	56	397	7.0	3	9	2
Aug. 1-4, 6-11, 13-25, 27-31......	--	6.5	.59	48	9.4	14	2.0	125	54	24	.2	3.0	242	159	56	399	7.1	3	9	2
Sept.1,3-15,17-30...	--	4.2	.10	48	8.6	14	2.0	124	47	24	.2	3.5	230	156	54	384	7.2	3	9	2
Time-weighted average............		6.8	0.30	59	12	15	2.3	139	74	28	0.2	3.4	294	197	83	465	--	7	9	3

a/ Sodium plus potassium as sodium.

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23

Stream and location	Sampling point mileage index number	Latitude (° ' '')	Longitude (° ' '')
Niagara R. at Niagara Falls	0158(19.6)	43 03 28	79 01 11
Drainage ditch near Getzville	0158-12-1-5a(0.6)	43 02 04	78 47 27
Ellicott Cr. at Williamsville (2185)	0158-12-1(14.1)	42 57 10	78 44 15
Trib. to Ellicott Cr. at Mill Grove	0158-12-1-16(0.4)	42 56 51	78 33 13
Ellicott Cr. at Mill Grove (2184.5)	0158-12-1(28.8)	42 56 09	78 33 06
Spring Cr. at Alden	0158-12-1-18(0.4)	42 54 30	78 29 32
Durkee Cr. near Alden	0158-12-1-18-1(1.2)	42 53 10	78 27 51
Ellicott Cr. at Alden	0158-12-1(35.3)	42 54 51	78 29 41
Ellicott Cr. near Crittenden	0158-12-1(39.9)	42 55 54	78 26 26
Elevenmile Cr. near Fargo	0158-12-1(41.4)	42 55 21	78 25 27
Elevenmile Cr. near Darien Center	0158-12-1(43.1)	42 54 02	78 25 24
Bull Creek at Hoffman	0158-12-3(1.4)	43 03 56	78 49 23
Trib. to Sawyer Cr. near St. Johnsbury	0158-12-3-1a(0.8)	43 05 24	78 51 59
Trib. to Bull Cr. at Mapleton	0158-12-3-3(0.9)	43 07 22	78 48 41
Bull Cr. at Mapleton	0158-12-3(7.1)	43 07 23	78 47 33
Bull Cr. near Mapleton	0158-12-3(10.0)	43 09 17	78 47 21
Trib. to Tonawanda Cr. near Wendelville	0158-12-3a(2.8)	43 06 03	78 47 36
Trib. to Tonawanda Cr. at Wendelville	0158-12-5(0.0)	43 04 08	78 45 13
Ransom Cr. near Swormville	0158-12-6(2.5)	43 03 10	78 43 42
Trib. to Black Cr. at Swormville	0158-12-6-3-1(1.3)	43 02 48	78 41 49
Black Cr. at Swormville	0158-12-6-3(1.1)	43 03 33	78 41 50
Got Cr. near East Amherst	0158-12-6-4(3.5)	43 00 04	78 40 57
Trib. to Got Cr. near Clarence Center	0158-12-6-4a(0.1)	43 00 01	78 40 33
Trib. to Barge Canal near Lockport	0158-12-7-1(3.2)	43 08 28	78 40 48
Mud Cr. at Millersport	0158-12-8(0.5)	43 05 24	78 41 50
Trib. to Mud Cr. at Raymond	0158-12-8-2(0.2)	43 06 14	78 39 42
Trib. to Mud Cr. near Rapids	0158-12-8-4(0.4)	43 06 33	78 36 11
Trib. to Mud Cr. near Wolcottsville	0158-12-8-4a(2.2)	43 08 21	78 31 42
Trib. to Mud Cr. at Wolcottsville	0158-12-8-4b(0.3)	43 06 54	78 31 04
Mud Cr. at Wolcottsville	0158-12-8(15.1)	43 07 13	78 31 06
Tonawanda Cr. at Millersport	0158-12(14.1)	43 05 10	78 41 50
Tonawanda Cr. at Rapids (2180)	0158-12(19.5)	43 05 35	78 38 11
Beeman Cr. near Hunts Corners	0158-12-9(1.2)	43 03 29	78 36 25
Trib. to Beeman Cr. near Hunts Corners	0158-12-9-1(2.4)	43 01 15	78 36 10
Trib. to Tonawanda Cr. at Sand Hill	0158-12-10(2.0)	43 03 35	78 33 23
Beaver Meadow Cr. at Swifts Mills	0158-12-11-1-1(0.8)	43 03 36	78 31 48
Murder Cr. at Akron	0158-12-11-1(8.4)	43 00 56	78 29 26
Trib. to Murder Cr. at Pembroke	0158-12-11-1-3a(0.6)	42 59 47	78 27 12
Murder Cr. at Pembroke	0158-12-11-1(12.4)	42 57 55	78 26 21
Murder Cr. at Pembroke (2177)	0158-12-11-1(13.0)	42 59 37	78 26 08

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23 (Continued)

Stream and location	Sampling point mileage index number	Latitude (° ' '')	Longitude (° ' '')
Murder Cr. near Pembroke	0158-12-11-1(15.1)	42 58 31	78 26 45
Trib. to Murder Cr. near Corfu	0158-12-11-1-7(2.4)	42 58 05	78 22 24
Murder Cr. at Sawens	0158-12-11-1(26.9)	42 55 15	78 21 16
Murder Cr. at Darien	0158-12-11-1(29.5)	42 53 39	78 20 50
Trib. to Ledge Cr. near Akron	0158-12-11-2(0.5)	43 02 04	78 22 24
Trib. to Tonawanda Cr. near Swift Mills	0158-12-14(0.5)	43 04 44	78 28 31
Tonawanda Cr. near Alabama (2175)	0158-12(46.9)	43 05 28	78 27 15
Tonawanda Cr. at Indian Falls (2174)	0158-12(54.1)	43 01 38	78 23 52
Trib. to Tonawanda Cr. at Indian Falls	0158-12-20a(0.0)	43 01 39	78 23 51
Trib. to Tonawanda Cr. near Indian Falls	0158-12-22a(0.1)	43 01 10	78 22 00
Trib. to Tonawanda Cr. at North Pembroke	0158-12-25-1(0.3)	43 01 16	78 19 44
Bowen Cr. near Alexander	0158-12-28(8.0)	42 56 13	78 17 17
Bowen Cr. near Alexander	0158-12-28(11.4)	42 54 09	78 17 53
Tonawanda Cr. at Batavia (2170)	0158-12(69.2)	42 59 51	78 11 20
Trib. to Tonawanda Cr. near North Alexander	0158-12-31a(2.9)	42 56 45	78 14 17
Trib. to TonawandaCr. near Batavia	0158-12-31b(0.2)	42 58 11	78 11 17
Little Tonawanda Cr. near East Alexander	0158-12-32(1.1)	42 57 17	78 11 18
Trib. to Little Tonawanda Cr. near East Alexander	0158-12-32-1(0.7)	42 56 48	78 10 32
Little Tonawanda Cr. at East Alexander	0158-12-32(4.1)	42 55 46	78 11 35
Little Tonawanda Cr. at West Bethany	0158-12-32(5.3)	42 54 59	78 11 56
Trib. to Little Tonawanda Cr. near Linden	0158-12-32-4(0.0)	42 54 08	78 10 40
Little Tonawanda Cr. at Linden (2165)	0158-12-32(9.4)	42 52 37	78 09 48
Middlebury Br. at West Middlebury	0158-12-32-8(0.7)	42 51 44	78 09 05
Middlebury Br. near West Middlebury	0158-12-32-8(1.8)	42 51 34	78 08 26
Dusing Gulf Stream near Dale	0158-12-32-9(0.2)	42 50 31	78 10 40
Trib. to Little Tonawanda Cr. near Dale	0158-12-32-14(0.3)	42 48 30	78 09 59
Little Tonawanda Cr. at Dale	0158-12-32(15.2)	42 48 57	78 10 04
Trib. to Tonawanda Cr. at Brookville	0158-12-33a(1.8)	42 55 21	78 12 54
Trib. to Tonawanda Cr. at Alexander	0158-12-35(0.6)	42 54 04	78 14 28
Tonawanda Cr. near Attica (2164.6)	0158-12(85.6)	42 52 38	78 15 29
Trib. to Tonawanda Cr. near Attica	0158-12-39-1(0.1)	42 52 33	78 15 29
Baker Cr. at Attica	0158-12-39-3(0.2)	42 51 22	78 15 24
Baker Br. near Dale	0158-12-39-3(1.2)	42 51 16	78 14 18
Tannery Br. at Attica	0158-12-41(0.1)	42 52 11	78 17 05

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23 (Continued)

Stream and location	Sampling point mileage index number	Latitude (° ' '')	Longitude (° ' '')
Trib. to Crow Cr. at Attica Center	0158-12-46-2(1.9)	42 58 52	78 14 06
Johnson Cr. at Earls	0158-12-59(0.2)	42 47 32	78 19 18
Stony Br. at Varysburg	0158-12-66(0.1)	42 45 35	78 18 41
Tonawanda Cr. near Johnsonburg (2164)	0158-12(100.6)	42 43 05	78 19 18
East Fork Tonawanda Cr. near North Java	0158-12-77(0.2)	42 42 40	78 19 15
Tonawanda Cr. at Southburg	0158-12(106.0)	42 40 18	78 20 18
Scajaquada Cr. at Lancaster	0158-15(11.6)	42 54 51	78 42 35
Trib. to Scajaquada Cr. at Lancaster	0158-15-7(0.4)	42 55 02	78 41 50
Cazenovia Cr. at Ebenezer (2155)	E1-4(4.1)	42 49 47	78 46 33
Cazenovia Cr. at Spring Brook	E1-4(10.4)	42 49 10	78 41 09
Tannery Br. at East Aurora	E1-4-14-4(2.0)	42 46 03	78 35 46
East Branch Cazenovia Cr. at South Wales (2153.5)	E1-4-14(8.1)	42 42 12	78 34 50
Trib. to East Branch Cazenovia Cr. at Holland	E1-4-14-20(0.2)	42 39 02	78 33 02
East Branch Cazenovia Cr. at Holland	E1-4-14(13.6)	42 38 37	78 32 48
East Branch Cazenovia Cr. at Holland	E1-4-14(13.9)	42 38 23	78 32 38
*Trib. to East Branch Cazenovia Cr. at Protection	E1-4-14(18.2)	42 36 13	78 29 20
West Branch Cazenovia Cr. near East Aurora (2152.5)	E1-4-15(0.5)	42 45 16	78 39 06
Trib. to West Branch Cazenovia Cr. at Taylorshire	E1-4-15-4(0.2)	42 44 28	78 39 11
West Branch Cazenovia Cr. at West Falls	E1-4-15(5.4)	42 41 52	78 41 03
West Branch Cazenovia Cr. at Colden	E1-4-15(10.5)	42 38 38	78 41 05
Crump Br. near Glenwood	E1-4-15-19(0.1)	42 36 30	78 39 09
Sprague Br. near Glenwood	E1-4-15-21(0.0)	42 35 41	78 39 01
West Branch Cazenovia Cr. at Footes	E1-4-15(15.3)	42 34 56	78 38 40
Trib. to Spencer Br. near Scotts Corners	E1-4-15-22-3(0.1)	42 34 31	78 35 53
Graff Br. at East Concord	E1-4-15-23(0.8)	42 33 36	78 38 06
Plum Bottom Cr. at Lancaster	E1-6-6(0.5)	42 53 56	78 39 43
Cayuga Cr. near Lancaster (2150)	E1-6(11.0)	42 53 24	78 38 36
Trib. to Little Buffalo Cr. near Marilla	E1-6-7-7(0.2)	42 50 23	78 34 34
Trib. to Little Buffalo Cr. at Marilla	E1-6-7-10(0.1)	42 50 34	78 32 53
Little Buffalo Cr. at Marilla	E1-6-7(9.3)	42 50 13	78 32 48
Trib. to Cayuga Cr. near Cowlesville	E1-6-20(0.7)	42 51 49	78 29 50
Trib. to Cayuga Cr. near Cowlesville	E1-6-20(2.6)	42 51 48	78 27 53
Cayuga Cr. near Williston	E1-6(20.9)	42 51 28	78 30 19

* New York State Department of Health considers this to be the headwaters of East Branch Cazenovia Creek.

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23 (Continued)

Stream and location	Sampling point mileage index number	Latitude (° ' '')	Longitude (° ' '')
Cayuga Cr. at Cowlesville	E1-6(23.3)	42 50 28	78 28 14
Cayuga Cr. at Folsomdale	E1-6(24.9)	42 49 35	78 26 59
Right Branch Cayuga Cr. at Bennington	E1-6-30(2.2)	42 50 07	78 23 54
French Br. at Bennington	E1-6-30-4(0.3)	42 50 09	78 23 20
Cayuga Cr. near Persons Corners	E1-6(30.6)	42 47 30	78 23 53
Cayuga Cr. at Toziers Corners	E1-6(35.4)	42 44 16	78 21 29
Buffalo Cr. at Gardenville (2145)	E1(10.4)	42 51 17	78 45 26
Buffalo Cr. at Blossom	E1(13.8)	42 51 25	78 41 32
Buffalo Cr. at Elma (2144.7)	E1(18.0)	42 50 55	78 38 28
Pond Brook at Elma	E1-15(0.0)	42 50 54	78 38 26
Pond Brook near East Aurora	E1-15(4.1)	42 48 18	78 37 10
Trib. to Buffalo Cr. near East Aurora	E1-21(0.5)	42 47 36	78 35 33
Trib. to Buffalo Cr. near East Aurora	E1-22(0.2)	42 47 37	78 35 14
Trib. to Buffalo Cr. near Wales Center	E1-26(1.6)	42 46 03	78 33 17
Buffalo Cr. at Porterville	E1(27.1)	42 47 17	78 33 13
Buffalo Cr. at Wales Center	E1(29.5)	42 46 05	78 31 52
Hunter Cr. near Wales Center	E1-30(0.3)	42 45 38	78 31 46
Hunter Cr. at Colegrave (2144.1)	E1-30(3.7)	42 44 11	78 32 55
Hunter Cr. near Holland	E1-30(9.8)	42 40 56	78 30 36
Hunter Cr. near Holland	E1-30(11.6)	42 39 36	78 30 04
Stony Bottom Cr. near Wales Center	E1-31(0.1)	42 45 33	78 31 09
Stony Bottom Cr. near Wales Center	E1-31(2.0)	42 46 11	78 29 15
Buffalo Cr. near Wales Hollow(2144)	E1(31.8)	42 44 54	78 30 31
Sheldon Cr. near Strykersville	E1-40(0.2)	42 43 19	78 28 06
Sheldon Cr. at Dutch Hollow	E1-40(2.7)	42 44 13	78 26 28
Glade Cr. at Strykersville	E1-45(0.6)	42 42 28	78 27 07
Glade Cr. at Strykersville	E1-45(0.8)	42 42 31	78 26 56
Buffalo Cr. at Java Village (2143.7)	E1(40.9)	42 40 23	78 26 20
Beaver Meadow Cr. at Java Village	E1-55(0.1)	42 40 19	78 26 10
Trib. to Beaver Meadow Cr. near Java Village	E1-55-1(0.8)	42 40 19	78 24 16
Beaver Meadow Cr. near Java Village	E1-55(3.2)	42 39 57	78 23 22
Trib. to Buffalo Cr. at Java Village	E1-58(0.0)	42 39 47	78 26 25
Trib. to Buffalo Cr. near Java Village	E1-58-2-3(0.4)	42 38 19	78 23 19
Plato Br. at Java Village	E1-59(0.0)	42 39 40	78 26 26
Trib. to Plato Br. near Java Village	E1-59-1-4(0.6)	42 37 52	78 26 51
Plato Cr. near Java Village	E1-59(0.3)	42 39 28	78 26 19
Buffalo Cr. near Java Village	E1(42.2)	42 39 31	78 26 46
Smoke Cr. at Lackawanna (2142.5)	E2(3.5)	42 49 21	78 48 10

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23 (Continued)

Stream and location	Sampling point mileage index number	Latitude (° ' '')	Longitude (° ' '')
South Branch Smoke Cr. near Orchard Park	E2-1(4.5)	42 46 49	78 47 05
Trib. to Smoke Cr. near Orchard Park	E2-2(0.6)	42 47 20	78 44 25
Rush Cr. near Hamburg	E3(5.3)	42 44 55	78 48 36
Unnamed stream near Clifton Heights	E11(1.3)	42 43 27	78 54 53
Eighteenmile Cr. at Highland-on-the-Lake (2142.4)	E13(0.5)	42 42 45	78 58 00
South Branch Eighteenmile Cr. at Eden Valley (2142.3)	E13-4(2.9)	42 40 34	78 52 26
South Branch Eighteenmile Cr. at Clarksburg	E13-4(11.0)	42 37 29	78 50 18
Trib. to South Branch Eighteenmile Cr. near New Oregon	E13-4-14(0.1)	42 36 29	78 49 10
South Branch Eighteenmile Cr. at New Oregon	E13-4(15.5)	42 35 24	78 47 32
South Branch Eighteenmile Cr. at Wyandale	E13-4(18.8)	42 33 19	78 46 25
Hampton Br. near Hamburg	E13-6(1.3)	42 41 28	78 50 02
Hampton Br. near Hamburg	E13-6(2.6)	42 40 50	78 49 19
Neuman Cr. at Hamburg	E13-8(0.3)	42 42 48	78 48 33
Neuman Cr. near Hamburg	E13-8(1.6)	42 43 13	78 47 56
Chestnut Ridge Drainage near North Boston	E13-9(0.1)	42 42 03	78 47 34
Eighteenmile Cr. at North Boston (2142)	E13(15.3)	42 41 04	78 46 41
Anthony Gulf Stream at Patchin	E13-27(0.5)	42 39 32	78 44 55
Eighteenmile Cr. at Boston	E13(20.6)	42 37 42	78 44 29
Eighteenmile Cr. at Fowlerville	E13(22.8)	42 36 21	78 43 21
Eighteenmile Cr. near Fowlerville	E13(25.5)	42 34 45	78 41 43
Trib. to Eighteenmile Cr. near Fowlerville	E13-57(0.2)	42 34 59	78 42 07
Trib. to Eighteenmile Cr. near East Concord	E13-58(1.2)	42 34 31	78 40 39
Pike Cr. near Highland-on-the-Lake	E15(0.5)	42 42 02	79 00 09
Pike Cr. at Derby	E15(3.3)	42 40 47	78 58 20
Big Sister Cr. at Evans Center (2140.6)	E20(2.2)	42 39 24	79 02 09
Rythus Cr. near Pontiac	E20-2(0.8)	42 38 23	78 58 14
Trib. to Rythus Cr. near Eden	E20-2a(0.3)	42 38 09	78 56 21
Rythus Cr. at Eden	E20-2(5.9)	42 39 02	78 53 34
Big Sister Cr. at North Collins	E20(12.0)	42 35 41	78 57 12
Hussey Gulf Stream at North Collins	E20-15(0.2)	42 32 54	78 56 29
Delaware Cr. near Angola (2140.4)	E21(1.5)	42 37 46	79 03 15

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23 (Continued)

Stream and location	Sampling point mileage index number	Latitude (° ' '')	Longitude (° ' '')
Muddy Cr. near Farnham (2140.3)	E22(1.2)	42 36 54	79 04 54
Cattaraugus Cr. near Irving	E23(0.0)	42 34 07	79 08 10
Cattaraugus Cr. at Irving	E23(1.6)	42 34 05	79 06 16
Big Indian Cr. near Versailles	E23-5(1.8)	42 30 43	79 02 36
Clear Cr. near Iroquois (2140.1)	E23-6(0.9)	42 32 34	79 00 56
North Branch Clear Cr. near Lawtons	E23-6-4(0.6)	42 31 30	78 56 32
Trib. to North Branch Clear Cr. near Langford	E23-6-4-10(0.6)	42 33 14	78 50 31
Clear Cr. at Bagdad	E23-6(10.2)	42 28 58	78 55 07
Trib. to Cattaraugus Cr. at Gowanda	E23-16(0.7)	42 27 40	78 57 15
Grannis Br. near Gowanda	E23-18(1.4)	42 28 01	78 54 51
Cattaraugus Cr. at Gowanda (2135)	E23(17.4)	42 27 50	78 56 10
Cattaraugs Cr. above Gowanda (2134.98)	E23(19.4)	42 26 36	78 56 19
South Branch Cattaraugus Cr. at Forty Bridge near Gowanda	E23-20(1.2)	42 25 34	78 53 49
South Branch Cattaraugus Cr. at Cattaraugus	E23-20(9.4)	42 20 24	78 51 29
Gowan Hollow Br. at Cattaraugus	E23-20-7(0.3)	42 20 02	78 51 18
Jersey Hollow Br. near Otto	E23-20-11-2(2.0)	42 20 09	78 48 08
Mansfield Cr. near Eddyville	E23-20-11(1.8)	42 20 56	78 47 10
Mansfield Cr. at Maples	E23-20-11(5.5)	42 19 52	78 43 29
South Branch Cattaraugus Cr. near Otto (2134.9)	E23-20(14.4)	42 21 54	78 48 06
Trib. to South Branch Cattaraugus Cr. near Otto	E23-20-12(0.6)	42 22 29	78 48 32
Trib. to South Branch Cattaraugus Cr. near Otto	E23-20-12(1.2)	42 22 47	78 48 45
Trib. to South Branch Cattaraugus Cr. near Otto	E23-20-12-1(1.7)	42 23 16	78 49 54
Trib. to South Branch Cattaraugus Cr. near Otto	E23-20-12(2.7)	42 23 26	78 48 38
Trib. to East Otto Cr. near East Otto	E23-20-13(1.0)	42 23 24	78 43 52
South Branch Cattaraugus Cr. at East Otto	E23-20(18.5)	42 23 31	78 45 18
Waterman Br. near Zoar Bridge, near Springville	E23-21(0.2)	42 26 44	78 49 36
Cattaraugus Cr. at Zoar Bridge, near Gowanda	E23(26.9)	42 27 23	78 48 47
Coon Br. near Zoar Bridge, near Springville	E23-25(0.3)	42 27 40	78 46 50
Connoisarauley Cr. at Frye Bridge, near Springville	E23-27(0.1)	42 28 14	78 44 53
Trib. to Connoisarauley Cr. near Ashford Hollow	E23-27-2(2.5)	42 25 11	78 44 01

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23 (Continued)

Stream and location	Sampling point mileage index number	Latitude (° ' '')	Longitude (° ' '')
Connaisarauley Cr. at Ashford Hollow	E23-27(6.2)	42 24 17	78 41 09
Trib. to Connoisarauley Cr. at Bellow Corners	E23-27-6(1.4)	42 24 34	78 40 13
Derby Br. at Frye Bridge, near Springville	E23-28(0.1)	42 28 29	78 45 00
Spooner Cr. near Scobey Bridge	E23-30(0.4)	42 29 17	78 43 18
Spooner Cr. near Springville	E23-30(2.3)	42 30 31	78 42 26
Spooner Cr. at Concord	E23-30(4.8)	42 32 05	78 43 54
Spring Br. at Felton Bridge near Springville	E23-32(0.1)	42 28 53	78 41 05
Spring Br. at Springville	E23-32(2.6)	42 30 45	78 39 48
Spring Br. at Springville	E23-32(3.3)	42 31 09	78 39 50
Spring Br. near Springville	E23-32(4.0)	42 31 50	78 39 31
Buttermilk Cr. at Edies Siding	E23-33(0.4)	42 28 51	78 40 32
Buttermilk Cr. near Springville (2134.5)	E23-33(1.5)	42 28 21	78 39 54
Gooseneck Cr. at Riceville	E23-33-5(1.0)	42 26 34	78 36 51
Buttermilk Cr. at Riceville Station	E23-33(5.0)	42 26 02	78 37 48
Buttermilk Cr. at West Valley	E23-33(7.4)	42 24 14	78 36 44
Trib. to Cattaraugus Cr. near Riceville	E23-36(2.7)	42 28 47	78 35 54
Cattaraugus Cr. near Springville	E23(46.9)	42 30 51	78 34 57
Hyler Cr. near Sardinia	E23-42(0.0)	42 30 47	78 34 27
Hyler Cr. near Sardinia	E23-42(1.8)	42 31 45	78 34 54
Dresser Cr. near Sardinia	E23-43(0.2)	42 30 48	78 34 05
Dresser Cr. near Sardinia	E23-43(1.7)	42 31 47	78 33 37
King Br. near Sardinia	E23-45(0.2)	42 30 41	78 33 06
Elton Cr. at The Forks (2134.2)	E23-48	42 31 05	78 31 00
Trib. to Stony Cr. near McKinstry Hollow	E23-48-1-1(0.1)	42 29 02	78 32 36
Lime Lake Outlet at Delevan	E23-48-3(0.4)	42 29 20	78 29 12
Trib. to Lime Lake Outlet at Delevan	E23-48-3-1(0.3)	42 28 56	78 29 16
Lime Lake Outlet at Delevan	E23-48-3(1.3)	42 28 38	78 28 53
Lime Lake Outlet at Lime Lake	E23-48-3(4.8)	42 26 07	78 28 34
Elton Cr. at Delevan	E23-48(3.6)	42 29 21	78 28 58
Trib. to Elton Cr. near Elton	E23-48-4-1(0.7)	42 28 41	78 25 31
Trib. to Elton Cr. at Elton	E23-48-6(0.1)	42 27 04	78 25 26
Elton Cr. at Elton	E23-48(8.1)	42 26 56	78 25 44
Trib. to Beaver Lake near Farmersville Station	E23-48-9(0.5)	42 27 10	78 23 13

Table 24.--Cross-index of sampling point mileage index number and latitude and longitude of sampling sites reported in tables 17 to 23 (Continued)

Stream and location	Sampling point mileage index number	Latitude (° ' ")	Longitude (° ' ")
Elton Cr. near Farmersville Station	E23-48(13.0)	42 25 18	78 22 26
Elton Cr. at Farmersville Station	E23-48(14.0)	42 25 29	78 21 57
Cattaraugus Cr. at Sardinia	E23(51.9)	42 31 39	78 30 31
Hosmer Br. at Sardinia	E23-50(0.2)	42 31 40	78 30 29
Hosmer Br. at Sardinia	E23-50(1.0)	42 32 28	78 30 16
*Dry Cr. near Sardinia	E23-50-3-1(0.8)	42 34 06	78 31 56
Hosmer Br. at Chaffee	E23-50(1.7)	42 34 02	78 29 45
Trib. to Cattaraugus Cr. at Cheery Tavern near Yorkshire	E23-51(0.8)	42 32 28	78 28 51
Cattaraugus Cr. near Arcade (2134.1)	E23(54.7)	42 32 13	78 27 28
Trib. to Clear Cr. at Sandusky	E23-56-9(0.6)	42 29 57	78 22 29
Skim Lake Outlet at Sandusky	E23-56-11(0.1)	42 29 24	78 22 47
Clear Cr. at Sandusky	E23-56(4.7)	42 29 16	78 22 07
Clear Cr. near Freedom	E23-56(6.0)	42 28 50	78 20 50
Trib. to Clear Cr. at Freedom	E23-56-15(0.7)	42 29 05	78 19 25
Clear Cr. at Freedom	E23-56(7.5)	42 29 18	78 19 16
Cattaraugus Cr. at Arcade	E23(56.7)	42 32 09	78 25 14
Spring Br. at East Arcade	E23-67(0.7)	42 33 45	78 20 36
Cattaraugus Cr. at East Arcade	E23(61.7)	42 34 11	78 20 47
Trib. to Cattaraugus Cr. near East Arcade	E23-69(0.3)	42 36 56	78 19 59
Cattaraugus Cr. at East Java	E23(65.7)	42 37 20	78 20 28
Erie (Barge) Canal at Lock 35, at Lockport	E230(0.8)	43 10 12	78 41 38
Erie (Barge) Canal at Pendleton	E240(0.0)	42 05 06	78 44 02

* New York State Department of Health considers this to be a tributary to Dry Creek.